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Ideals and Immediate Problems.

IT is fitting that science and technology should sometimes take stock of their spiritual position; and we are prompted to set down a few observations on that side of things because of an address recently delivered in Oxford by Sir Michael Sadler, Master of University College, to the congress of the National Union of Students. This is a body of whose main concerns one is the fostering of international friendship among students; and Sir Michael Sadler, doubtless taking his cue from his city and his audience, dealt with the enormous increase in the number of universities during the last half-century. He adduced four causes for the growth (we quote here and elsewhere from the *Times* report of the address): "First, a new class had risen to political power; second, women claimed their share in the educational opportunities of men; third, the East demanded access to Western science; and, fourth, college training had superseded apprenticeship as the most convenient and systematic form of preparation for a large number of callings."

But, in addition to these social and economic changes, Sir Michael pointed out, there are deeper causes at work, both intellectual and spiritual: scientific advance and achievement, for example, and "the belief that every human being should have access to an education appropriate to his or her powers." The extension of the franchise, the claim for equality of the sexes, international commingling, and the admission of the equal rights of every human being, are all, like the educational experiment begun in England in 1870, merely symptoms of the new era of recognition of the individual, called democracy, which, for good or ill, is growing out of the older period of oligarchy and autocracy. For good or ill, we say; the issue is not yet clear. Upon the quality of the world's handling of itself, and upon the wisdom with which it guides itself, until as a whole body it has learnt to use its new functions aright, will depend whether or no it is to wax into maturity or wane into a jungle of rank and tangled weeds.

It is to save ourselves from debasement that we must

meditate on the things of the spirit underlying our humdrum and prosaic daily life. We cannot hope to find a panacea; the old counsel still holds good: "Work out your own salvation with fear and trembling"; but let us watch for signs to guide us in our attempt to see the way. Here is one, a quotation from an article in the current issue of *The Hibbert Journal*, on "How the young Japanese dream of Oxford." The author, who is Professor of English in the High School of Yamagata, says: "The students of Japan . . . still love and admire the English, but this feeling will soon diminish unless the English language is presented as something other than a potent factor in international commerce, and the English nation as something more than a successful imperial power. . . . I quickly discovered that the best way, not only to interest them, but to promote international good feeling, was to talk to them about . . . those things in which England is truly great, namely, her literature, science, and political craft."

Another hint of a possible means of help is found in Sir Michael Sadler's proposition that a university is an instrument through which new views find organised expression: by way of a network of personal influence it carries new thoughts into the professions and public services; it winnows new ideas, interprets discoveries, and colours the texture of educational opinion. Surely, then, it is for those of us who most clearly see the need for contact with the immaterial that informs the material, the invisible that permeates the visible, to join hands with the universities and lend them our aid. Particularly at Oxford and Cambridge, imbued as they are with the delicate aroma of the past, and accustomed by centuries of habit to processes of pure thought, but to a great extent also at the newer universities, there are opportunities for withdrawal into silent places, where the mind grows because the body is at rest, and has freedom to travel through great spaces, to meditate on things that last, to wonder at the quietness of the stars. What have things like these to do with us as engineers and technicians? Just this: science is beginning to realise that if she would see the universe aright she must take into account not only the material and physical attractions that the stars have for each other, but also the immaterial and psychical attractions that they have for men's souls.

It may be that a forecast made by Sir Michael Sadler towards the end of his address will come true: men and women may hurry more and more into commerce at an early age, and try to get "something comparable on the intellectual side with a university education" in their leisure time. We hope not: already

> The world is too much with us; late and soon,
> Getting and spending, we lay waste our powers;
> Little we see in Nature that is ours;
> We have given our hearts away, a sordid boon!

Nothing will ever take the place of the placid opportunities that the life of a university affords; to be most truly distinguished, the individual must have room for all-round growth; an untimely rush into buying and selling blunts the finer susceptibilities, and dulls the due appreciation of the nice balance that must ever exist between the rights and the duties of every human being. If it is objected that we have written of ideals when the immediate problem is the recovery of industry, we will answer that where there is no vision, the people perish.

The Domestic Uses of Electricity.

The letter on water-heating which we published in our issue of March 30th, from the pen of Mr. Edward Dixon, has aroused a good deal of interest. His point is the familiar one, that central heating with coke is cheaper than with electricity. To attempt to controvert this statement would be foolish; the method that he advocates is undoubtedly the cheapest of all—*cheapest in respect of cost of energy*.

But is "cheapness" in that one particular to be the sole consideration? Does Mr. Dixon buy the cheapest boots that he can find in the market? Does he hold that English beef is "out of the discussion" because chilled meat can be bought at a lower price? And does he travel on foot to save money? If so, we agree that he is consistent in selecting the "cheapest" method of heating water.

There are, however, as correspondents point out elsewhere in this issue, other considerations which weigh with those who value comfort, cleanliness, and convenience, and other factors which enter into the true account of cost. From the earliest days electricity has suffered from the complaint that the quarterly bill was not necessarily less than the gas bill; people who readily conceded that electricity was the best illuminant were aggrieved if its cost was higher than that of its rival. Surely they could not expect to get the best article for the lowest price! Nowadays, for the same standard of illumination, domestic electric lighting in general costs less than gas lighting; where a higher account is rendered, it will be found that, as usually happens, the adoption of electric lighting coincided with an increase of 100 or 200 per cent. in the degree of illumination demanded and supplied. But from the very commencement, there have been present those savings due to the less frequent renewal of decorations, the longer life of curtains, upholstery, and bookbindings, the reduction of domestic labour, and the improvement in health and spirits, which cannot be expressed precisely in cash, but undoubtedly accrue to the user of the electric light.

But as in Mr. Dixon's case, the same old argument is put forward that electric heating, unquestionably the best method available to the householder, must also be the "cheapest" in cost of energy before it can be discussed! Both for cooking and heating, without fear of contradiction, we claim that electricity is the very best agent; it is worth paying for at double the rate of any rival; and the savings incidental to its use, though generally disregarded, go far to reduce its real cost. Who can appraise the value of getting the smell of gas out of the house?—Even that is worth a good deal. Moreover, electricity can be supplied for domestic uses generally at a very low price with profit to the seller, and where this fact is realised by the supply authority, the consumer has no ground for complaint.

We earnestly advocate the supply of electricity at the lowest possible price, in order that its benefits may be extended to the greatest possible number of consumers, and that the electrical age may be brought into being at the earliest moment; but we do not say that electricity is dear in this country, except in certain areas. We claim that in any case it is worth paying for, even at a higher rate than its rivals, because *it is worth more*.

The Burden of Taxation.

In our "Business Notes" to-day we refer to a memorandum on "The Burden of Local Taxation" which has been drawn up by the Engineering and Allied Employers' Federation. The matter is one which has been urgent for several years past, but conditions have been allowed to drift from bad to worse. In the speeches at engineering and electrical companies' annual meetings, the disastrous effects of excessive local rates have been stressed again and again, and the time is approaching when the Government will be compelled to revise the Poor Law system. It is an anomalous feature of existing methods that in the very localities where poverty and distress are greatest the rates are the highest, thus depressing still further industries which are already badly hit. Local rates enter directly into production costs and the reduction of these costs is the first essential if British industries are to compete with foreigners in the home and export markets. Thus we are faced with a problem which is national in its effects and cannot be dealt with on a local basis.

It is to be hoped that the Government will apply itself immediately to the alleviation of this burden upon industry by broadening the incidence of poor relief and by a thorough examination of the whole subject of unemployment and its effects, as suggested by the Engineering Employers' Federation.

Electricity Supply—I. Generation.

In these articles the data recently published by the Electricity Commissioners are analysed, and illustrated by a number of diagrams.

By D. J. BOLTON, Author of "Electrical Engineering Economics."

IN the ELECTRICAL REVIEW recently the latest return of the Electricity Commissioners* was referred to as a veritable mine of information, and so in truth it is, but like other mines it requires a good deal of " working " before its contents can be fully utilised. It is not everyone who has time to delve below the surface layers (those useful summary tables) and the author has therefore endeavoured to bring out some of the more deeply hidden treasures of this mine, and to present them in a manner which can be readily grasped. In analysing a return of this kind, consisting as it does of an enormous mass of figures, there are two things to be aimed at. One is to express the figures themselves in a graphical form as far as possible, so as to bring out their relative proportions and significance. The other is to compare the results with those of previous years in such a way as to show clearly the progress that has been made, and the trend of present-day practice.

The return which has just been published (which must be clearly distinguished from the regular Annual Reports) gives the full Engineering and Financial Statistics relating to Authorised Undertakings in Great Britain for one year, namely, that ending December 31st, 1925, for the companies, and ending March 31st or May 15th, 1926, for the municipalities. In what follows this will be referred to simply as the year 1925. There have been two previous returns of this kind, the first covering three years (1920-23) and the second two years (1924-25). It is therefore possible to compare the results of six complete years of public electricity supply in this country, starting with the year 1920—*i.e.*, to discern the progress made in five years, although it will be noted that some of the particulars now given were not available for the earlier years.

In the following table are shown some of the outstanding figures. The first column gives the figures for the year under review (1925), whilst the second and third columns refer to the previous year (1924) and to the first year for which figures are available (1920 unless otherwise stated). As regards the last two columns it was thought best to give in some cases not the actual figures for the earlier years, but the percentage increases which the last year shows above these earlier years, and in these cases the figure is distinguished by a plus sign. Thus, item 1, the installed capacity at the end of 1925, shows an increase of 19 per cent. over that of the previous year, and 81 per cent. over that at the end of 1920. Item 2, the aggregate maximum load, is also distinguished by percentage increases over the previous years. The ratio of item 2 to item 1, given on the next line, shows that there was an installed capacity at the end of 1926 of a magnitude 73 per cent. in excess of the maximum demand on the stations. This figure, to reduce which is one of the chief objects of interconnection, seems at present to be rather on the up-grade, the values being 62 per cent. for 1924, and 50 per cent. for 1920.

The units generated (item 4) have increased in very much the same ratio as the maximum load, giving a steady load factor of approximately 30 per cent., although this was lower in some of the intermediate years. The fuel consumption and the mean price charged per unit have both declined steadily and substantially in the four or five years concerned, whilst the consumption per head of population has gone up some 50 per cent. Items 10 and 11 show that the domestic consumption is a steadily increasing proportion of the total, and that the capital costs of transmission and distribution are also going up, being now well over half the total capital expenditure.

Item	Figures for period of one year ending Dec. 31st, 1925 (or March-May, 1926).		Figures for, or change since: 1924.	1920 (unless otherwise stated).
1	Installed capacity at end of period (million kW)	4·42	+19%	+81%
2	Aggregate maximum load during period (million kW)	2·56	+11½%	+57%
3	Ratio of item 1 to item 2 ...	1·73	1·62	1·50
4	Total units generated (millions)	6,620	+10%	+55%
5	Mean annual load factor ...	30%	30%	30%
6	Average fuel consumption per kWh (lb coal or equivalent)	2·43	2·55	[27% in 1921] 3·40
7	Number of undertakings generating over 1,000 kWh per ton	41	27	11 in 1922
8	Mean selling price per unit sold (pence)	1·65	1·75	2·48 in 1921
9	Units sold per head of population	128	117	82
10	Domestic consumption as percentage of total	22·2%	20·3%	16·5%
11	Capital cost of transmission and distribution (as percentage of total capital expenditure) ...	56·1%	54·6%	46·2% (1921)

In what follows, an attempt will be made to illustrate some of the above figures graphically, particularly as regards generation.

Figs. 1 and 2 are circular diagrams showing how the total generating capacity of the country is made up. In each case the area of the outer (full) circle represents

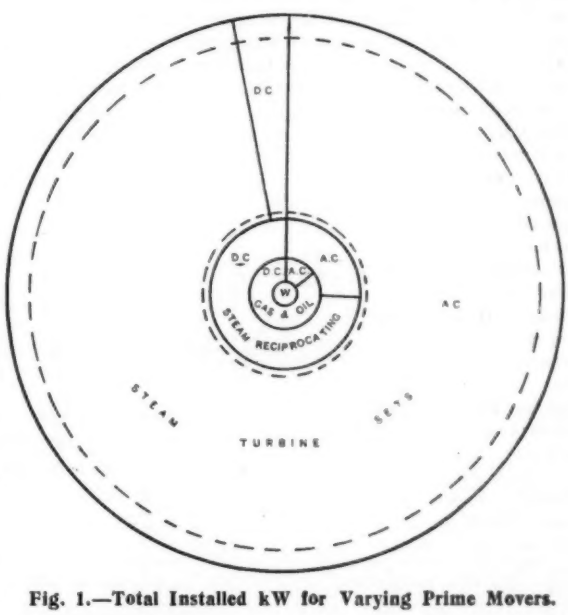


Fig. 1.—Total Installed kW for Varying Prime Movers.

the total kW capacity installed at the end of 1925, whilst the dotted circles give corresponding totals for 1924. Fig. 1 illustrates the types of prime mover employed, the outer ring showing steam turbine sets, the next ring steam reciprocating sets, the inner ring gas and oil engine sets, and the small inner circle water-wheel sets. The method of concentric rings has been chosen in order not to swamp completely the smaller types, since steam-turbine sets actually represent 92 per cent. of the whole, and water-power sets only 0.2 per cent. Each concentric ring has been divided into two portions by radial lines, according to whether the generators are a.c. or d.c., and it will be seen that whilst the great majority of the turbine sets are a.c.,

*Electricity Supply, 1925-26. Electricity Commission Return of Engineering and Financial Statistics. Published March, 1928. H.M. Stationery Office: price 12s. net.

most of the reciprocating plants are d.c. (This division has not been attempted in the case of the water-power sets.) The dotted circles representing the previous year's totals have not been divided up into a.c. and d.c., since this would make the diagram unnecessarily confusing; and it will be seen that as regards the two years, there has been a considerable growth in

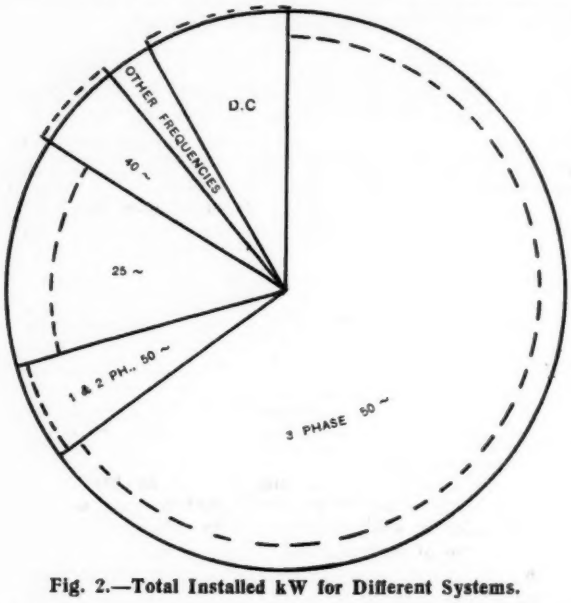


Fig. 2.—Total Installed kW for Different Systems.

the steam turbine capacity, a shrinkage in the steam reciprocating sets, and no appreciable change in the non-steam sets.

Referring to fig. 2, the area of the outer circle represents the same thing as before, namely, the total installed capacity at the end of 1925, but this is divided up radially so as to show the kind of electricity generated. Nearly two-thirds of the total is three-phase 50 periods, and another appreciable slice is at the standard frequency, but on systems using only one or two phases. Of the remainder, 25 periods is the largest slice, 40 periods being less than half as much, whilst d.c. plant comes intermediately between these two. In showing the figures for the previous year, the same sectors have been employed, and dotted arcs have been drawn so as to enclose areas representing the kW at the end of 1924. Comparing the full and dotted segments, it will be seen that 1925 shows an appreciable increase over the previous year in the 50-period plant, but an increase also in the 25-period equipment which is greater in proportion although, of course, less in actual amount. The 40-period and d.c. plant both show slight decreases. It should be explained, however, that a portion of the increases shown is due to a change in the rating of existing plant, namely, from the output at which the efficiency is a maximum, to the maximum output of which the plant is capable.

Coming now to the performances of the individual undertakings and generating stations, there are two outstanding pieces of information which are particularly worth noting—the efficiency of the generation process as evinced, for example, by lb. of coal burned (or number of calories) per unit generated, and the efficiency of the undertaking as a whole as shown by such items as the mean price per unit charged for the energy. A study which is of particular interest and value is to trace the correlation, if any, which exists between these two values and the size of the station to which they refer. In the present article only the former point, that of generation efficiency, will be considered.

The relationship between the station size and generation efficiency is one which has often been investigated and in a variety of ways, although whatever method is adopted there are difficulties in carrying it out. One way is to take the size groups given in the Electricity Commissioners' annual returns of generation, and to compare the mean consumptions in each group. This, however, gives only a somewhat rough guide to the average position, and, moreover, it gives no indication whatever of the amount of variation between the individual stations. On the other hand, when separate stations are dealt with (as is done in the figure below), it must be remembered that there are many varying circumstances besides the size of plant which affect the result, amongst which may be mentioned station personnel, cooling-water facilities, and so on. Another difficulty in this method arises from the large number of stations which have to be dealt with.

As regards the actual basis of comparison, the simplest one, and that followed here, is the pounds of coal burnt per unit generated. This, of course, is open to the very obvious objection that it takes no account of calorific values, so that a station burning low-grade fuel will inevitably appear worse than it should. But many stations appear to have difficulty in furnishing accurate figures for their mean calorific values, and in the return under consideration, these values are

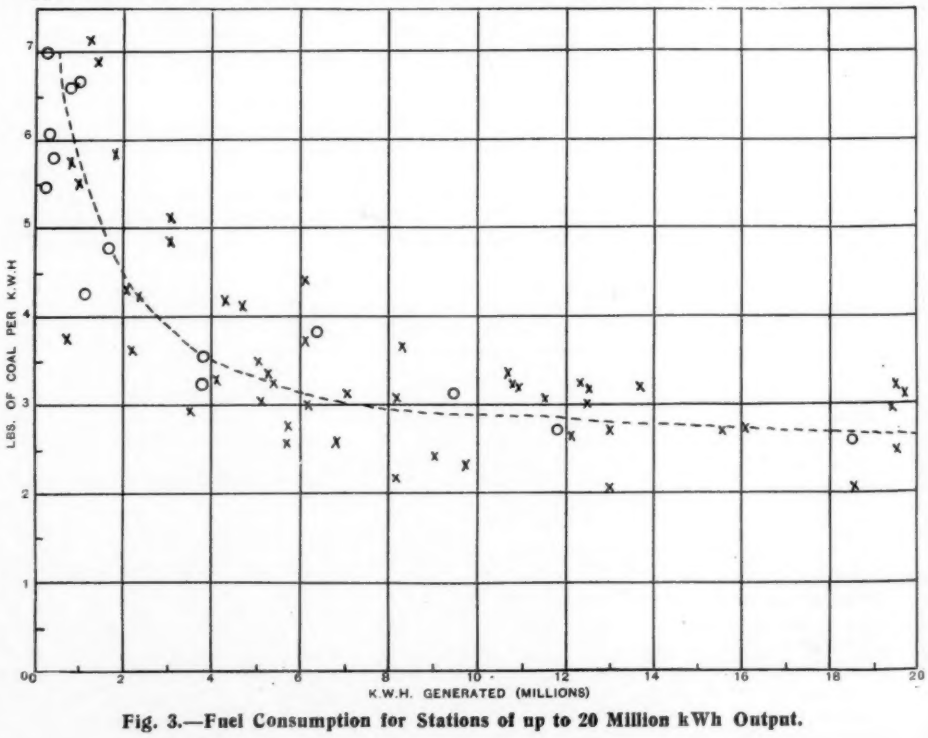


Fig. 3.—Fuel Consumption for Stations of up to 20 Million kWh Output.

omitted entirely. Moreover, the alternative plan to treat the *cost* of the fuel instead of its weight would introduce difficulties owing to varying distances from the coalfields and, therefore, varying costs of transport.

Hence, whilst it is not pretended that "lb. of coal per unit" is a perfect or final criterion, yet it does represent a pertinent and simple standard which is easily and accurately obtainable. Further, by taking a sufficient number of stations the other differences will probably cancel out sufficiently well to enable the general correlation between size and efficiency to be traced with some accuracy.

In the accompanying graphs (which follow the general lines of those published in the ELECTRICAL REVIEW on January 1st and February 5th, 1926), pounds of coal per unit are plotted against the total units generated in 1925. Each point represents a single station, the municipal undertakings being represented by crosses, and the companies by circles.

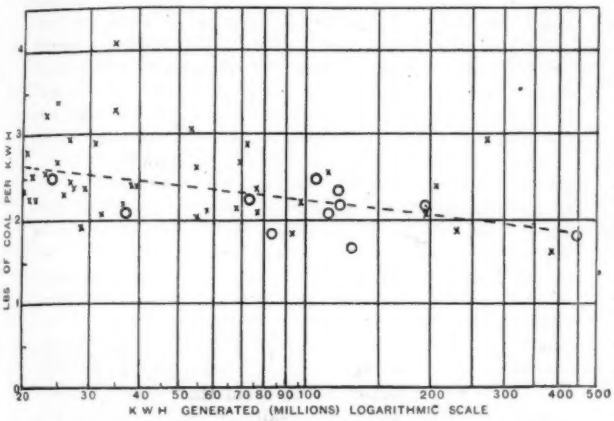


Fig. 4.—Fuel Consumption for Stations above 20 Million kWh Output.

In the case of the very large stations (those having outputs in the neighbourhood of 100 million units or more), every authorised undertaking has been included, but in the other cases the following steps were taken to simplify and cut down the numbers. Only English undertakings were considered, Scotland and Wales being omitted. All undertakings consuming other than coal and all those purchasing some or all of their energy have been omitted, and likewise all the company undertakings in which several stations are grouped under one management without individual figures being given. As this would still leave too many of the very small stations for satisfactory plotting, only about half the smaller undertakings are shown on the graph. (The output at which the change is made is 9 million units per annum, as below this size the number of stations rapidly increases). In order to avoid any discrimination between stations, the method of doing this was to include only half the alphabet (A—L) for both municipal and company undertakings alike, of outputs below the figure mentioned, so that the points shown can be taken as truly representative of the whole.

The first graph, fig. 3, shows the stations having annual outputs of up to 20 million kWh, the only omissions besides those mentioned above being one or two very small stations whose consumptions exceeded the maximum point on the scale (7½ lb. per unit). The second graph, fig. 4, continues this for the larger stations. It has the same ordinate scale, but values along the base are scaled logarithmically so as to cover a sufficiently wide range. The conclusions from these diagrams are sufficiently obvious to need very little comment. In the first place, the wide divergence between individual stations, even of the same size, will be noticed. In the second place, there is a very marked decrease in the coal consumed per unit with increasing size of station. Starting with the really small stations the drop in consumption with size is at first very great, and there can be no doubt that outputs of less than 10 million kWh per annum do not represent an economic size of station. Above this output the fall is much less marked, but it still appears to hold, even up to the largest stations shown, although there are hardly enough of the latter to establish definite conclusions.

It is difficult, not to say dangerous, to attempt an "average" of these figures and probably the best plan is to assess their general effect at sight. But in order to assist the eye in this, a dotted line has been tentatively drawn amongst the points in such a way that there are about as many stations above the line as below it, taking into account both numbers and distances from the line. This is hyperbolical in shape at first, but flattens out after about the 10-million mark, and it then continues fairly straight even with the logarithmic base scale of fig. 4.

"Grid" Load Dispatching.

The operation of the National "Grid" will involve operating difficulties in maintaining "balanced" loadings and normal line conditions; the author outlines methods of control in the light of experience gained on our present interconnected areas.

By H. W. C.

AT the present time we are hearing a good deal regarding the future of the electricity supply industry, and anything that is different to the normal operation is by some accepted as possible in the future. In view of electricity's rapid growth and experience of the past, coupled with rapidly changing principles, and in some cases their complete reversal, this state of common thought is perhaps not surprising. To those in small isolated systems, the operation of large systems is unfamiliar, and the latter, if interconnected to form a national "grid," will certainly be subjected to alterations affecting their general mode of operation.

In the opinion of the author such modifications will be due rather to increased connected capacity than to the introduction of new principles. We have at present in this country undertakings comparable in size with those of the proposed national scheme, and from these we can gain a fair idea of the difficulties likely to be met with in the future. Operating engineers have always been used to working under both normal and abnormal conditions, and their experiences have been helpful in showing what may be expected, although different disturbances rarely give rise to the same phenomena. In any case a study of the variables is both interesting and essential to correct operation.

We have not yet devised an instrument that will tell us what will happen in the future, and we therefore have to forecast as well as possible the forthcoming conditions by reference to past experience.

For normal running we shall have to consider the economic loading of the interconnectors and power stations, which as a rule involve no more than principles well known and ably discussed. The first move, then, is to determine the conditions obtaining in each local area or section.

As previously mentioned, the operating engineers,

now risen far above their humble beginnings as switchboard attendants, have to be alert to cope with variations from the normal running they have been used to; their duties are more complicated, and their scope is enlarged by the innovations of modern times. The duty of the transmission engineer is to maintain economic running, and so secure the full advantages of interconnection. Communication difficulties have, with regard to the control of circuits, limited the area which can be conveniently directed from one centre, while the subdivision of switching control is also necessary.

Fig. 1 is a suggested lay-out for a large interconnected system, showing the disposition of the power stations,

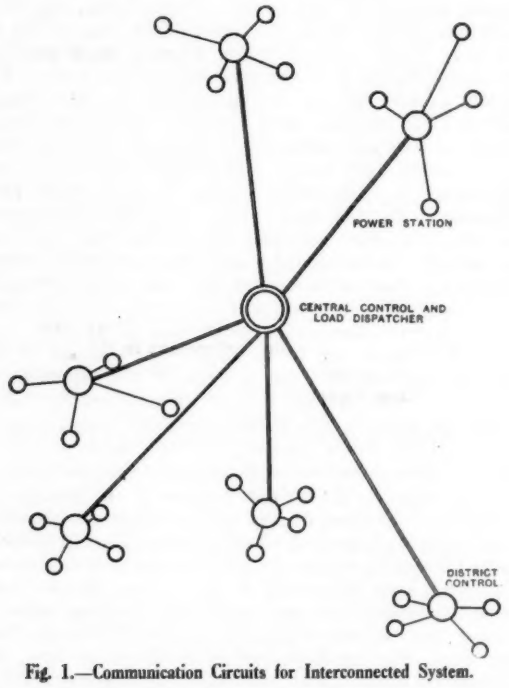


Fig. 1.—Communication Circuits for Interconnected System.

the sub-control offices, and the main central control office for the load dispatcher. The communication circuits are clearly shown, but these must not be confused with the power mains. This lay-out is necessary, if for nothing else, by reason of the expense and impracticability of the many long telegraphic and telephonic lines that would be otherwise required. Each sub-office will receive its instructions from the central office, such instructions being dependent on the electrical conditions of the main interconnectors between the district power-station groups, and also on any other information given to the load dispatcher from the sub-offices. Each power station will control its load according to the limits imposed by the directions received from the sub-control office. These directions will be based on the indications in the sub-office of the local power station conditions and the power-station e.h.p. tie-line loadings, and also upon any further information received from the individual power stations.

The control of power-station loadings is naturally affected by abnormal conditions on the various circuits. The demand is in the normal way out of control, but coordination of supply and demand has to be economically maintained; the arrangement is inflexible as a whole. Even when the loads of various consumers on a large system are combined and considered as a whole, sharp rises and falls are distinctly noticeable, and have to be suitably dealt with. It is not possible to effect any precise regulation of the demand by means of tariffs. Colliery pumping loads may possibly in their areas serve within limits to regulate the demand.

An ever-present possibility of demand variation is system disturbance, perhaps the widest variation of all. Of the disturbances due to weather, sudden storms effect the most pronounced local variation; over a wide area the effect is not usually rapid and as a rule causes little remark. Other weather conditions cause widespread daily differences, as they usually affect both domestic and industrial lighting demands. Probable variations due to local holidays and industrial disputes can be predetermined with fair accuracy. Seasonal variations in this country are chiefly due to the increase or decrease of lighting and heating requirements.

The supply frequency must be limited in the extent of its variation, as steady frequency is important in certain industries, particularly so in the manufacture of textiles. The loading of interconnectors is at times liable to rapid rises and falls, and cannot be left without some control. If precise regulation of the frequency is desirable, hand or further automatic control gear is necessary, as it is difficult to maintain constant speed on the turbines to the degree of accuracy required of the frequency. Further, it is not always practicable to design different turbines so that they will share their loads exactly over wide ranges. The interconnector characteristics, where the power stations are situated at great distances apart, determine to an appreciable extent the sharing of any load fluctuation. Practice has proved that large systems cannot be left to themselves in the matter of load sharing and frequency regulation, if these have to be kept within close limits. A small station can make very little difference to the frequency of a large system, but in the large schemes now in operation the largest station of a group governs to a great extent the supply frequency. When many power stations are interconnected on one system, regulation from one station only is not likely to be satisfactory, due to the large ratio between the total connected capacity and that of the particular station. Many who have had experience in the running of large and small generating sets in parallel will realise the truth of this statement.

The electrical characteristics of the system and the machines constitute only a part of the cycle of factors to be considered. Boiler-house plant also plays a part in determining the final result. Boilers fed by the readily controllable firing systems are able to cope with sudden load variations more efficiently than others. Pulverised-fuel firing may be put first, retort-type stokers second, and chain-grate stokers last in their relative ability to meet sudden variations in the load. The capacity and arrangement of the draught plant also affects the issue.

Centralised control is essential for any system where the total load is subject to wide variations. The power transmitted over the interconnectors between different industrial areas, and between cities and manufacturing localities where the former have appreciable traction loads, is liable to fluctuate widely. Main interconnector and local power-station loads indicate the change of load in the districts, while the frequency variation of the system indicates the change of the total loading. The former is dependent on steam conditions obtaining locally, and the latter on any sequence of events that may result in abnormal conditions over a large area. Due to this dependence on steam conditions, maintenance from a *central point* of station loading would, by reason of the numerous *minor* variations, involve too much work. Increase in the size of the system has shown that steady conditions are more satisfactorily maintained. The periodical load variations referred to above are usually very regular, but are often so great that control from a single central point is almost impossible.

As the load demand is not readily controllable, a rapid decrease usually results in a corresponding increase of the frequency. If each of four stations on one system attempted to maintain its load closely at a fixed figure, the frequency would suffer seriously. Due to the slight time lag between the variation of a power station loading and its manual correction, a certain amount of flexibility is secured, and this serves a very useful purpose. The usual procedure is to alter the loading of each station gradually in turn in a succession of small increments or decrements. The extent of the alterations

depends on the degree of variation in the local network load, and its proportionate effect on the system frequency. In the case of the four power stations on one system the method would be, on rising frequency, to decrease the load by decrements of from two to four per cent. of the station load at intervals of from 1 to 3 minutes. Each station would then by the manual control of the turbine governors maintain the load called for by the central control engineer or load dispatcher. Conditions on the system other than frequency cannot normally be indicated at each of the several power stations.

The frequency rise directs the action of the load dispatcher, and the extent of its variation or its rate of change determines how often it is necessary to "change load." When the frequency of the system becomes normal, the generation at each power station by directed control follows the normal load variation of its local area. In the event of one of the power stations falling behind in its supply to the system, due to internal trouble, suitable measures to redistribute the load can be taken by the load dispatcher; wastage of steam can similarly be minimised.

For the largest systems sectional control may be necessary, each section distributing the load according to instructions from a central office, the function of which is to regulate by transference of the load. For the successful operation of such a scheme efficient telephonic and telegraphic communication is necessary; the former method is suitable for abnormal conditions, but for dealing rapidly with the great amount of routine work, the latter is much to be preferred.

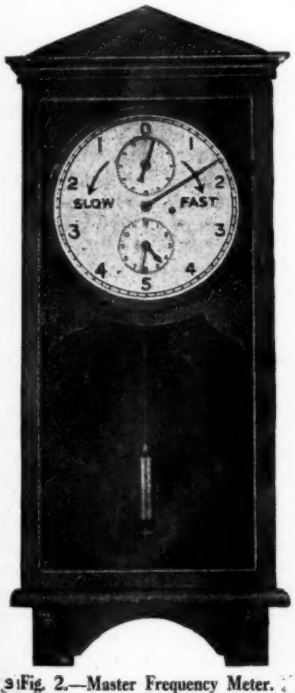


Fig. 2.—Master Frequency Meter.

Indications of the power - station and interconnector loadings must also be given at the point of control. For distances of ten miles or so remotely controlled indicating wattmeters serve a useful purpose. The Fawsett instrument, which employs a thermo-electric method of control and indicates on a calibrated millivoltmeter, is suitable in this connection. For greater distances a mechanical indicator, telegraphically controlled, is suggested as suitable. For indications of the system frequency a deflectional frequency instrument of wide range and high accuracy is necessary—something better than the usual vibrating-reed switchboard instrument. A pointer driven by a differential movement, similar in type to that of an Aron supply meter, and connected between a precision clock and a synchronous motor connected to the supply, will show any slight deviation from the correct frequency, and, even though it be not used to maintain a fixed average, it will show, by its slow rotation, close agreement with the required frequency.

Fig. 2 shows an instrument supplied by Messrs. Everett Edgcumbe, Ltd., which indicates with extreme accuracy any departure from the normal system frequency. It consists of a central pointer differentially connected between a precision clock and a small synchronous motor, so that at correct frequency the pointer remains stationary, and for rise or fall in frequency it moves with a corresponding speed in a forward or backward direction, respectively. An ordinary switchboard deflectional frequency meter is subject to errors due to voltage and wave-form variations, but these, it is suggested, may, if necessary, be avoided by using a small synchronous motor-generator to supply the indicator. An instrument constructed upon precision lines may, however, be evolved to meet the case.

Indicators similar in form to the usual office date indicators, remotely or manually operated, should be provided to give at a glance the boiler, generator and interconnector capacities where the latter are numerous and where they are affected by switching as the result of faults or normal maintenance conditions. Indicators may be necessary to show the direction and amount of power transmitted over interconnectors between district groups.

Indicators may be necessary to show, for supervisory purposes, the directions sent to power stations, and to show the acknowledgment by the receiving parties of these directions. If indicators remotely controlled (after the manner of a remote indicating wattmeter) are provided to show station outputs, instruments to show acknowledgments are not so necessary.

Fig. 3 gives an impression of the equipment necessary for the use of the load dispatcher. The centre panel has placed at the top a frequency indicator of suitable accuracy; this may be used as an alternative to the indicator shown in fig. 2; assuming normal conditions, it determines the major operations of the dispatcher. The counter shown below records the output demanded from the particular district to which the panel refers. Immediately underneath is another counter, remotely operated from a summation instrument in the particular sub-office or district control room, showing the actual loading. These instruments may be more cheaply con-

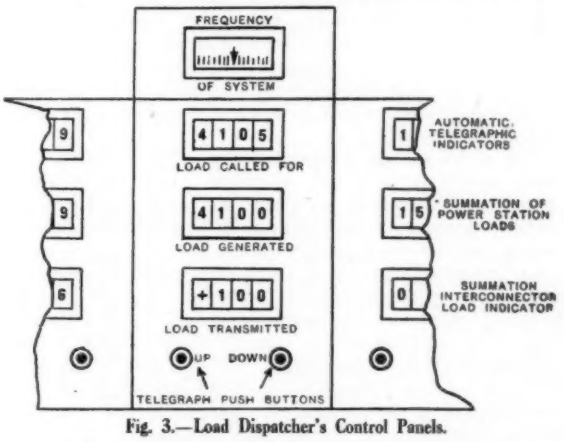


Fig. 3.—Load Dispatcher's Control Panels.

structed, if thought desirable, in the dial form with a pointer movable by hand, placed over the remote indicator, to show both the load generated and the load requested on the instrument dial, by electrically and hand-shifted pointers respectively. The bottom instrument is also remotely controlled, and shows at a glance the amount and direction of power transmitted over the interconnector or connectors between the particular district concerned and the others on the system. The push buttons shown are merely arbitrary in actual form, but show the suggested means of transmitting the routine request. It would also be useful, though not essential, to have a hand-operated "memory tickler," after the style of the usual office date indicator, to show the capacities of the generators, boilers and interconnectors of each district. Each district or sub-control office will have a panel upon which instruments or counters will be mounted, recording the instructions transmitted from the central office, and also a remote summation instrument giving at a glance the total power generated in the local area; this indicator will be the master control for the central instrument. Master control meter movements will be situated in this control room to control the remote indicator in the central office, to show the amount and direction of power transmitted over interconnectors to other groups of the system as mentioned above. In this sub-office, a panel for each power station controlled, identical with that in fig. 3, will be provided. The

nature of the instruments may differ slightly, but their function will be the same. At each power station an instrument and master transmitter will show the total load of the power station locally and at the district or sub-office control room respectively. The only other provision here is a receiver to record the directions transmitted from the sub-office. Minor variations will thus be dealt with locally, while major operations of importance to the district will receive attention at the sub-office. Major operations of importance to the system will be dealt with by the central load dispatcher.

It will be seen that load dispatching becomes an important feature in the largest systems, and recourse may have to be had to wireless for the communication requirements where the power stations are very great distances apart.

The load-dispatching *personnel* should be reduced to the minimum, as communication tends to become retarded when relayed at different points. With the best regulation of the boilers, steam wastage is difficult to avoid unless special equipment is provided to indicate accurately the steam demand where heavy load fluctuations occur. There is very little flexibility between the steam and the electrical portions of the power station. The centralised control of the boiler plant on various large systems has been described in the Press, and the descriptions available should be helpful in solving some of the difficulties that are met with.

The Maintenance of Motors, Starters and Controllers.

In the following article the authors deal in a practical way with means and methods for the prevention of and remedy for troubles commonly met with in the installation and running of electric motors and control equipment.

By E. DAINE DAWSON, Graduate I.E.E., A.M.I.Mech.E., and JAN. KUKA, A.M.Am.I.E.E.

THE engineer who has the least trouble with his plant is the one who thoroughly understands the construction and operation of the various units and draws up a plan of action for times of breakdown or mishap. He is generally found prepared for trouble in the equipment, which he instantly locates, diagnoses and prescribes for.

The chief sources of trouble met with in electrical installations arise from improper care or neglect in the specification of the plant—not coping fully with its output demand—or improperly and unmethodically laying out the same, or even from bad designing and poor workmanship in manufacturing the accessories, and thus giving rise to constant trouble which is chiefly experienced in motors and their control gears. The object of this article, therefore, is to give a few important hints on rectifying the "kinks" that are likely to be met with under working conditions and to safeguard and insure against these as far as possible, saving thereby time, labour, and expense.

To deal first with a.c. equipment, it is a little difficult to distinguish between faults which exist when starting for the first time and those which arise in service, and it is easier to assume that all the defects occurred when the gear was put into commission.

The fundamental necessity for a customer is to check the specification of the order with the actual goods received, as there is every likelihood of some stupid mistake creeping in, owing to the innumerable hands the order has to pass through on its way through the manufacturer's works and the purchaser's staff. It is needless to attempt to detail that which the comparison readily reveals. Electrical machines, after they are manufactured according to the demands of the customer, are subjected to special tests. These are commonly known amongst manufacturers as "standard tests," and it is absolutely essential that customers should be represented by technical experts at the performance of these tests to assure them of the efficient working of their machines, regardless of the expense involved in doing so, as the author believes this to be the best and surest way of checking defects pertaining to the specification, and especially defects in manufacture. The initial costs incurred by so doing would amply be repaid by the efficient working of their plant, as customers possessing efficient machines obviously decrease the costs of maintenance and repair, as well as increase the efficiency of the productive operations; this is proof of insurance against breakdown, and consequently a safer investment than plant of freakish and inefficient design.

There are other mistakes or oversights which may exist, even if the orders and the plant correspond, and the most usual are those in connection with the overload releases, the rotor particulars of slip-ring motors, and the starting torques.

Overload releases depend on the characteristics of the supply system and the motors. Thus, a three-phase, three-wire supply system, neutral not earthed, requires two overload devices (fuses or trip coils on the breaker), while a three-phase, three-wire system, neutral earthed, requires three overload devices somewhere in the feeder circuit running to the motor. If, in the latter case, only two releases are provided, a fault occurring on the unprotected phase may cause serious trouble, because the fault can only be cleared by some breaker away back on the system which happens to have a release in that phase, and which on operating causes a shut-down of a large part of the plant. Economy can be effected and greater protection obtained, with slip-ring motors not fitted with brush-lifting and short-circuiting devices, by installing one breaker with two or three overload releases, as may be required, and one no-volt release for each group of motors, and also by protecting each motor by means of a breaker with one overload coil only in the rotor circuit. The main breaker will take care of faults between phases or to earth, and cut off the group on a general failure of supply. The single overload coil in any of the rotor phases operates with ordinary mechanical overload on the rotor, and also on the failure of the supply in any one phase of the stator. This method cannot be adopted when brush-lifting devices are fitted, because the coil in the rotor is inoperative with the slip-rings "shorted." One no-volt release only is fitted to take care of a general failure of supply; it is useless to fit more in an attempt to secure operation when one phase fails, because the motors act as transformers, keeping the faulty phase charged up and, therefore, the no-volt coils being energised, no release is obtained. The first important things to ensure are that the correct number of overload devices for the system are used, that they are installed in the most advantageous positions, and that they are correctly connected.

Relatively to the overload devices, no-volt coils are

of secondary importance; if they fail to open the breaker, the overload coils will do so when the supply is resumed. The point is emphasised because, should the supply be shut down gradually, the plunger would simply float to its normal "off" position and fail to release the trip.

As regards the rotor particulars of slip-ring motors, the four common oversights are in failing to mention whether brush-lifting and short-circuiting devices are fitted, in stating the slip-ring voltage, in defining the rotor connections, and in failing to state whether one of the slip rings is earthed or not.

There is never any doubt about the slip-ring voltage of a star-connected rotor, because it is equal between all the rings, but some people give "phase voltage," and this may mean either the pressure to the star points or the pressure between the rings. The case is different with an L-connected rotor, where the voltage between one pair of rings is 1.4 times that between the others, and "phase voltage" may mean the voltage to the common point or the higher voltage between the outers. Most motor makers insulate all three slip-rings, but a few mount one of the rings directly on the shaft, thereby earthing it.

It is common practice for the switchgear maker to earth the star-point of the starting resistance. If one ring and the star-point of the resistance are earthed and the rotor is star-connected, one leg of the resistance is "shorted" and the other two legs are subjected to 7 per cent. excess pressure; the current rush being heavy, the motor starts suddenly, and the resistances in consequence heat up to three times the normal and eventually burn out.

It is necessary to see that all the rotor particulars have been given correctly, and that the starting resistance has been constructed correctly.

The data regarding starting torque are one of the chief sources of trouble for the user and the manufacturer of starting gear.

The motor should start on the first notch, and a definite current must be passed to obtain this. The starting torque has been ascertained with sufficient accuracy for certain classes of plant, but all that is known for the greater number of applications is that "heavy" or "light" starting is required, and this may mean anything, but usually means nothing. It is not at all easy to predetermine the starting torque unless similar motor-driven plant exists from which readings may be obtained, and, generally speaking, no two jobs are the same.

The result is that the starter maker has to adopt average proportions suitable for average cases. There is no such thing as "light" starting unless the motor runs up on a loose pulley; even a short length of badly-erected shafting may take as much power to start as the load itself. Far better results could be obtained in the absence of definite data if the user simply described the use to which he intends to put the motor.

A common source of misunderstanding is the variety of slip-shod expressions used for starting effort. One is "starting against full-load torque." This means that full-load torque must be exerted to start rotation, and implies that the torque required to continue rotation is very much less, probably not more than 65 to 70 per cent. of full-load torque. The other is "starting against full load," which is a very different thing, and may mean a starting torque of three or four times that of full load, as in the case of loaded trucks.

The next source of uncertainty is regarding the accelerating torque, which information is never given to a manufacturer. It is obvious that when the starting torque has been applied and the motor is running at a certain low speed, only half the job has been done, because the motor has then to be brought up to full speed at a rate depending on what it is driving, and it should be brought up smoothly and regularly; it is worse than useless to take a long time to start up by waiting on the notches if the load is jerked in a dangerous and violent manner as the starter is moved from notch to notch. The starter maker should be told the time in which it is desired to accelerate from standstill to full speed. This is particularly important in the case of a crane where the gears are designed to stand certain stresses, or a haulage where the rope is proportioned for a definite maximum pull.

Again, in the absence of information, the maker has to standardise on an average figure, such as one minute, which means that all the notches have to be traversed in 60 seconds. The time to be waited on each notch simply depends on the rate at which the motor is speeding up, and this is best judged by the hum; when the note has become steady and uniform, the starter arm may be moved to the next notch. This determines the natural time of starting for a particular job and starter. If the time appears too short, the acceleration too rapid, and the current rushes too severe, a starter with a greater number of notches is required. If, on the other hand, the time is longer than desired, and the acceleration too slow, a starter with fewer notches is needed. If the time, acceleration, and current rushes seem right, but the time is longer than the rating specified by the makers, the starter is too small, and another should be obtained. This is indicated at once by excessive heating of the grids. The heating is also affected by the cycle of operations. Thus, the maximum temperature rise, usually 350 deg. F. for ventilated starters, 150 deg. F. for liquid starters, and 100 deg. F. for oil-cooled starters, may be permitted in a single start if the cooling period, that is, the time the resistance sections of the starter are out of action while the motor is running at full speed or standing, is sufficient to allow the starter to cool down completely. This time varies with each starter, and may be one hour with a small well-ventilated starter, or twelve hours with a large, totally enclosed, oil-cooled or a large liquid starter.

The suitability of a starter for working on a cycle of, say, four starts per hour, can only be judged after the apparatus has been working under these conditions for sufficient time to arrive at a steady temperature, above which it does not rise when the cycle is repeated indefinitely.

It is often inconvenient and costly to test a starter by performing a tedious cycle at possibly full load, for, say, six hours. Fortunately, it is not necessary to do this; all that is required is to take the temperature rise on one start, then keep current on the starter till the maximum temperature rise specified is attained, switch off the current, and take cooling readings at equal intervals of time until the temperature has dropped well below its maximum for the single start. Then, if in the cooling interval the starter temperature does not fall by the amount it gained at the single start, its final temperature on a continued cycle will be greater than that specified, and the starter too small. A larger one should be obtained, and its correct proportions could be readily calculated from the data derived.

It must be remembered, when heating up a starter for a test like this, that the resistance is graded in respect of time; for example, a 7-notch, 1-min. rated starter might have the section between notches one and two rated for 10 seconds, that between notches two and three for 20 seconds, and so on, and if the current is simply applied and maintained, the earlier sections will get red hot while the later ones are quite cool. It is necessary to heat the whole starter regularly by starting and stopping the motor in the usual way several times in succession in order to heat each section equally. An alternative method when two similar starters are available is to connect the two in series without the motor and couple the handles, so that when a section is cut out of one starter a similar section is inserted in the other, and the total resistance in circuit is maintained constant. Temperature readings should be taken on the first and last sections to obtain an average figure.

Another consideration affecting the satisfactory working of the starter is the alteration of the resistances with temperature. It is no use trying to get accurate

results if the value of the resistance depends on the temperature it happens to have acquired at the moment. This occurs with all starters fitted with cast-iron grids, wrought-iron-wire resistances, or liquid starters. The increase of resistance with cast-iron is from 10 per cent. to 15 per cent., and with wrought-iron about 125 per cent. for a 350 deg. F. rise. The best results are only obtainable with alloys having negligible temperature coefficients; these alloys, if of a durable nature, are more expensive than iron.

Returning for a moment to the statement that the motor should start on the first notch, if everything else is satisfactory, the best thing is to short-circuit sufficient of the resistance between notches one and two to allow the motor to start; if one half or more of this section has to be shorted, the starter is not suitable.

The exception which proves the rule is the case of a motor on an inadequate supply system, where the authorities are compelled to stipulate that the current passed on the first notch must not exceed a value determined by the capacity of the supply mains. Inadequacy of supply is responsible for a good many vagaries, and one of these is the use of any starting gear other than a switch or breaker for motors of one, two, or three horse-power, which can very well be thrown direct to line without damage to themselves and with considerable benefit to the user's pocket.

(To be continued.)

Infringement of Trade Names.

The Principles involved in a Recent Case.

By W. ERIC JACKSON, LL.B., Barrister-at-Law.

ONE of the inevitable legal difficulties which exist in a trade like the wireless trade, which has arisen comparatively suddenly from nothing into a national industry, is that in the flood of products which are within a few years poured out on to the market, there should exist articles which resemble each other so closely as to be mistaken by the public one for the other.

An instance of this is provided by the case of La Radiotechnique v. Weinbaum, which recently came before the Chancery Court.* The plaintiffs and defendants both deal in wireless valves, and in the course of marketing their goods, use the words "Radio Micro" as a form of trade description. Now it is, of course, quite possible that, with the limited supply of words available to radio manufacturers (for example, "radio," "broadcast," "electron," "magnetic") for use as descriptive terms, and in view of the enormous variety of radio products, two manufacturers might unwittingly stumble upon the same combination of words, just as inventors working separately often produce inventions which are almost identical. More especially would this be so where one firm is French and the other English; for the field of possibility is greatly widened.

But whatever the cause may be the adoption by rival manufacturers of similar trade descriptions is bound to lead to friction. It appears that in the case above mentioned, the plaintiff firm alleged that the words "Radio Micro" were its own exclusive mark. On the other hand, the defendants said that for a long time they had been accustomed to use those words on their boxes and in their advertisements. The dispute was heightened by the fact that the cartons used by both parties were very similar and might have led purchasers to confuse the two products.

Now the Trade Marks Acts provide, as do the patent laws, adequate protection to traders who avail themselves of their provisions. A new trade mark, or a mark which has been in long use by one firm can be registered after due inquiry, and once it has been put on the trade-mark register, it becomes the exclusive property of the firm which registers it. In cases of any alleged infringement, the firm has only to come into Court and prove the date of registration, and an injunction against the infringers is granted as a matter of course.

The defendant has certain limited defences open to him, such as that the mark was registered by fraud, but in general, if there has been any imitation, even innocently, of the registered mark the Court will make an injunction.

In the "Radio Micro" case, the plaintiffs had not registered the words as part of their trade mark. The action was therefore based on the ground that the defendants, so it was alleged, passed off their goods as the goods of the plaintiffs in such a way as to be likely to deceive the public. The defendant in such instances has several powerful defences open to him. He can show that he has been using the mark for such a long time that he has acquired an established reputation with it throughout the trade. He can show also that the words are mere description, and are not of the nature of a trade mark, and he can also show that he had no intention to deceive and that no one was in fact deceived.

These defences are not open to a trader who has, even unwittingly, copied a registered trade mark. The action for "passing off" is based upon intention to deceive, and if the act was honest and free from deception, the plaintiff will have great difficulty in succeeding.

Of course, where a defendant directly and deliberately represents that the goods he manufactures are those of of the plaintiff, the case is easy to establish, but where a defendant honestly believes that his representation is true, as where he bought the goods from another for re-sale and had no means of knowing the true position, no injunction will be granted.

And it is necessary for a plaintiff also to show that, in the market where the defendant's goods were sold, the plaintiff's goods were also known. So if the defendant goes into a new district where neither party's goods have been heard of before, and sells his own goods under a name identical with that of the plaintiff, no action can be brought against him; for in such circumstances it cannot be said that any active deception has been practised which would be likely to confuse purchasers.

The deception complained of in a "passing off" action need not relate to the mark or brand upon the goods. It can be any act done in connection with the sale. Verbal statements across the counter, representations by travellers, the copying of the colour, size, shape, or mode of packing, will, if calculated to deceive, suffice to found a good action.

The trader's position, when he does not register a trade mark, is thus not without a certain legal protection. The "passing off" action can be pursued concurrently with or quite independently of any claim under the Trade Marks Acts. The relief granted is similar in both cases, namely, an injunction against the guilty party, surrender or destruction of the goods complained of, or removal of the deceptive feature and damages for the extent of the wrong done to the plaintiff's trade or an account of the profits wrongfully made by the defendant.

* Elec. Rev., March 23rd, p. 533.

Correspondence.

Correspondents should forward their communications **as early as possible.** *No letter can be published unless we have the writer's name and address in our possession.*

Unfair Trading.

With reference to your comments, and those of your correspondents on this matter, coupled with one's own bitter experiences, the writer is prompted to ask: Who practises "fair trading"? I am of the opinion that it would be an easy matter to pick out the manufacturers who have adopted "fair trading" as their slogan.

There is not the slightest doubt that Tom, Dick, and Harry can have what they want and as much as they require at the same terms as those given to a legitimate electrical engineer. It would serve no useful purpose for me to give what I consider glaring instances of unfair trading by so-called high-class manufacturers.

If, however, all contractors placed their orders with decent firms—there are a few—the others would find that they had killed the geese that laid their golden eggs.

To your correspondent "Contractor" I submit that boycott is better than compiling a black list, as we have the ball at our foot, and I can only describe the unfair methods at present practised in a word emanating from Hades.

Contractor No. 2.

April 2nd, 1928.

We notice that a certain London cigarette retailer who claims to be a manufacturer, is now distributing printed matter offering, amongst other goods outside the tobacco business, electric cleaners, and the following is an exact extract from this:—

The "Thor" electric suction sweeper; standard retail selling price	£9 9 0
Less R.D.S.A. discount (20 per cent.)	1 17 9
Net cash price to you, carriage and packing FREE	£7 11 3

A fully guaranteed *all-British cleaner.*

To the whole industry this is a *very* serious matter; to legitimate retailers it is a definite challenge.

Further, is the "Thor" an "all-British cleaner"?

L. G. Hawkins & Co., Ltd.
(L. G. HAWKINS, *Managing Director.*)

London, *April 2nd*, 1928.

Domestic Water Heating.

There is a reply to Mr. Edward Dixon's letter in your current issue on page 571 which is worth his consideration.

The point is, of course, that if everything in the house is done electrically, the resultant all-in cost can compare most favourably with the all-in cost of other methods. The cleanliness and convenience are really worth something extra. Electricity is one of the few commodities which are exhibiting a constantly falling price, whilst maintaining and increasing the stability of electricity supply finance, and it requires no prophetic inspiration to see that the cumulative effect of wider domestic use will very soon enable us to say that the electrical method is actually the cheapest—is it not already the best?

The average price per unit is the only governing factor, and now that electricity supply is entering its ordered era, that is unlikely to stop falling for long before it reaches 0.6d.

Already in many districts existing tariffs enable domestic consumers to buy at a cheaper average price than any other class, and where they are actively helped to realise this their business flows in quickly enough.

Like many others, Mr. Dixon, whilst expressing the assurance of a coke or other enthusiast, is keeping one wise eye on electrical methods and progress.

Invictus.

April 2nd, 1928.

Your correspondent, Mr. Edward Dixon, commenting upon the claims which have been put forward in your columns as to the advantages of the load to be obtained by encouraging the installation of electric thermal-storage water heaters, suggests that "from the power-station point of view . . . they are all beside the point." Amongst supply engineers, on the contrary, it is generally agreed that, from the power-station point of view, loads of this nature are vitally necessary for improving the load factor and thus raising what may be termed the "capital efficiency" of the undertaking.

In arriving at the running cost of his coke-fired boiler, Mr. Dixon apparently falls into a common error of including only the bare cost of fuel, and thus setting at nought the labour involved in firing, maintenance, and extra household cleaning. Had Mr. Dixon any experience of the labourless and trouble-free service of a well-designed electric storage system coupled with a good tariff, he would never willingly revert to any other means of obtaining his hot water.

Supply undertakings in various parts of the country are now quoting off-peak tariffs of the order of ½d. per unit, whilst a unit charge of ½d. is a common feature of the ordinary two-part domestic tariffs in a very large number of places.

Forty gallons of water at 195 deg. F. is equivalent to approximately 95 gallons at 110 deg. F. (an average temperature required for general household purposes), and this can be obtained with a consumption of about 17½ units, costing, at ½d. per unit, only 8¾d.

Mr. Dixon may accept the assurance that, at such tariffs as are now becoming popular, there is a big market for the sale of electricity for heating water, and that it remains only for supply engineers to encourage this market and control its development on lines which will ensure its yielding the maximum benefit for the improvement of load factor.

R. J. Hebbert.

Hollinwood, *April 2nd*, 1928.

Battery Eliminators.

Your article on "Wireless and the Supply Engineer" is of great interest, particularly the latter part relating to the h.t. eliminators for use on d.c.; surely these should not be allowed on d.c. circuits at all, as he states that unless a double-wound transformer is used in the 'phone circuit, it is highly dangerous. It would seem that the makers of these gadgets are in many cases absolutely ignorant of the three-wire system of supply with earthed neutral. How many sets have a transformer in the 'phone circuit? Not one in a thousand! And, again, of the thousands of cheap headphones sold, one hardly ever comes across one that is not leaking to case. The trouble is that thousands of people are posing as wireless experts who are utterly ignorant of the principles involved, both in this very interesting branch of the industry and in ordinary methods of electricity supply.

If the h.t. eliminator for d.c. is to continue to be sold, the dangers attendant on its use (and they are very real) should be pointed out to the public.

I have been an experimenter in matters radio since 1901, and have yet to find a more satisfactory method of h.t. supply than a good dry battery.

W. Gard.

Coleford, *March 31st*, 1928.

Your contributor on the above subject need have no fear of being thought an alarmist; he has understated the danger rather than otherwise.

As manufacturers of appliances for operating wireless receivers from supply mains we frequently receive inquiries for a d.c. "eliminator," but we have consistently maintained the view that such devices are not sound electrical engineering practice, and in the hands of the public are a danger both to life and property.

In the case of hospitals and other public institutions the danger is particularly acute, both by reason of the listeners' physical condition and the common use of headphones in such situations. We therefore in no circumstances supply equipment which results in the distribution wiring or the output points being in metallic connection with the mains (and hence, in most cases, at a high potential above earth). The skilled constructor is perhaps in a different category, though even here discrimination is necessary, but as regards the general public we should advocate the prohibition of the sale of d.c. eliminators, apart from those employing a double-wound motor generator or some such arrangement for isolating the wireless equipment from the mains.

At present it is quite possible for the unsuspecting user to have the exposed metal parts of his receiver (switches, dials, &c.), at a potential of anything up to 250 volts above earth, with the possibility of putting a dead short on his mains, not to speak of killing anybody who does not happen to be in fairly robust health. An electric kettle, for example, in which the metal work was necessarily "live" would not be tolerated for a moment, and there is no reason why wireless equipment should be on a different footing. The financial gain from the sale of such apparatus would be more than offset by the damage to the trade as a whole in the event of a serious accident at, say, a hospital, with attendant publicity. One can imagine the headlines.

Now that wireless apparatus has emerged from its earlier status as an occasional novelty, it is time that it fell into line with other domestic appliances for connection to public mains.

M. G. Scroggie, B.Sc., A.M.I.E.E.,
Chief Engineer, BURNDEPT WIRELESS, LTD.

London, *April 3rd*, 1928.

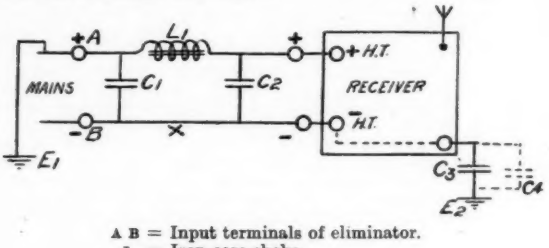
In his article on "Wireless and the Supply Engineer," which appeared in your issue of March 30th, Mr. Rawll refers to the interference to wireless reception caused by electrically-operated refrigerators and similar types of apparatus.

It may interest your readers to know that we have carried out a series of experiments in our laboratories with a view to devising a method of eliminating interference due to electric motors, electrically operated refrigerators, and similar apparatus. As a result of these experiments, we have evolved a method which gives very satisfactory results. It is not, of course, always possible completely to eliminate interference of this nature, although in many cases this has been done, but generally a considerable improvement will result when a suit-

able device is employed. We are now in a position to supply anti-interference units for this purpose, and would be pleased to advise any of your readers who may be interested. The method referred to has been protected by British Patent No. 275,081.

For **Dubilier Condenser Co. (1925), Ltd.**
A. M. KENNEDY, *Commercial Manager.*

Referring to Mr. R. H. Rawll's statement, in his article in your last issue (p. 546) on battery eliminators, that "it is something of a mystery" that eliminators function indifferently on the negative outer of supply mains, the following brief explanation, I hope, may be of interest to your readers. To the best of my knowledge this effect was first explained in an article of mine in the last October issue of *Experimental Wireless* (p. 614), to which those in need of further data and a formula for design are referred.



A B = Input terminals of eliminator.
L_1 = Iron core choke.
C_1, C_2, C_3 = About 1 to 3 mf. each.
E_1 = Electric Light Co.'s B.O.T. regulation earth.
E_2 = Wireless receiver earth.
C_4 = Stray capacities of receiver to earth.

Diagram of Filter Circuit.

Considering the above diagram, it will be seen that this represents a filter circuit h.p. eliminator connected to a wireless set with a normal aerial and earth.

The earth drawn at E_1 represents the state of affairs when the installation is worked off a positively earthed (negative) outer.

Now we know that "ripple" p.d.'s are produced across A and B, by the mains to which they are connected. If L_1 and C_3 are correctly proportioned they will filter the "ripple" out of the volts applied to the receiver in the usual way. But the ripple e.m.f. across AB will cause a "stray" a.c. current to flow from E_1 through C_3 (the earth blocking condenser in the receiver) and the wireless set back to B.

As shown, the capacities to earth of all the valves and other components of the receiver may be represented by C_4 parallel with C_3.

Then there will be appreciable p.d.'s produced across C_3 and C_4 by the "stray" current, which will be amplified by the valves and reproduced as interference in the loud-speaker or headphones of the receiver.

This is the cause of the trouble on negative outers. On positive outers there will be no stray current flow unless the earthed negative is allowed to become positive with respect to earth; this will never happen on correctly maintained mains.

The remedy in both cases is to insert a choke coil at X in the figure, when the p.d.'s across C_3 and C_4 will be obviously reduced.

For the correct values of the various quantities see the article above referred to.

J. H. Owen Harries.

Frinton-on-Sea, *April 3rd*, 1928.

The National Register.

To read one's contribution on a subject and a reply to that contribution in the same issue of a paper is, I should think, a novelty in journalistic practice. I have read Mr. Taunton's reply to my article with both interest and regret. There are, as he says, so many points on which we apparently hold views in common. His reply, however, bears indication that he is nettled at, and resents my reminder of, the genesis of the National Register and the reiteration of the fact that it is not merely the unruly offspring of the Electrical Contractors' Association, over which any member of that Association is entitled to claim the privileges of parental control and chastisement. A similar reminder, or perhaps I should say a mild hint to this effect, raised the ire and scorn of Mr. Pinto. But whose fault is this? Is the National Register to be blamed for its origin of birth and consequent status, or the Executive Committee for the ignorance or forgetfulness of registered contractors in this connection? Is the Executive Committee to ignore and contravene the constitution, objects, and obligations of the National Register under which it obtained the licence from the Board of Trade for registration by substituting contractors for the public as the dominant object of its activities? The electrical Press generally (including the ELECTRICAL REVIEW) one and all stressed the origin of the National Register in their issues, at the time it commenced operating, and my reminder of this position would hardly appear to be a legitimate or logical grievance, but so it appears to be claimed. Mr. Taunton's reference to other bodies seems to exhibit the same forgetfulness. Of course, the doctors, the lawyers, the plumbers, and a host of others he does not name, do control the operations of their "own" Associations, but these bodies were formed and founded by the members of their respective professions or trades. The National Register, notwithstanding its title, was not formed or founded by electrical contractors for electrical contractors, but by a combination of almost the whole of the bodies whose livelihood is involved in the electrical industry, and for the benefit of a much wider circle. If it had been intended otherwise, then there is no conceivable reason (except one which is obvious) why the Register should not have been conceived, born, and brought up under the roof and auspices of the Electrical Contractors' Association alone. The reference to this situation in my previous contribution, which certainly was not meant offensively, as I say, is apparently resented, and this resentment so colours the remaining criticisms and taunts in Mr. Taunton's reply that I need not, I think, make further comment than by saying that they have no foundation in fact, are unworthy of him and his previous articles, and, unfortunately, are negative and not constructive.

May I, however, refer to the recent meeting of members of the various Local Advisory Committees, at which contractor membership was in the majority? This meeting was called for the express purpose of giving those Committees the opportunity of stating their views on the conduct of the National Register. It was hoped that discussion would be helpful to the Executive Committee. I do not know if Mr. Taunton was present, but the subjects of grading, imposition of further qualifications and the like were fully ventilated, and discussion revealed the fact that contractors themselves were hopelessly divided and held divergent opinions on the subjects discussed. Obviously to adopt one set of proposals would lead to strong objection and recrimination from holders of contrary views.

One word more, and this with regard to the editorial note in the same issue, in which reference is made to the possession of editorial knowledge of the unsatisfactory working of the Register in some places and the non-existence of it altogether in others. I do not know exactly what is meant, but I would ask if it would not be better for the Editors and others who proclaim their interest in the progress of the National Register to bring the instances referred to to the notice of the Executive Committee? Specific facts or complaints may, but vague generalities cannot, be easily coped with. Every contractor, each in his own way, can assist materially in furthering the progress of the National Register, and by so doing conduce to his own benefit, and all assistance to this end will be welcomed by the Executive Committee. It may be the two will not always see eye to eye, but the progress both desire will, I fear, hardly be assisted by such fatuous complaints as both Mr. Taunton and Mr. Pinto make, that the Executive Committee has taken up and presents an attitude of professional aloofness, superiority, and so on, an attitude which I can assure them exists only in their too-sensitive imaginations. It is a charge which, in the circumstances, is as regrettable, puerile, and needless as it is devoid of foundation or justification.

Fredk. W. Purse.

Stratford, *April 3rd*, 1928.

[Referring to the opening sentence of Mr. Purse's letter, we can assure him that the course we adopted is not only a common practice, recognised and frequently followed by journals of the highest standing, but has often been exemplified in our columns on previous occasions without eliciting any adverse comment. Our purpose in this instance, as indicated in our leading article, was to bring the discussion to a close without further delay.—EDS. ELEC. REV.]

The Lead-Acid Storage Cell.

I am sorry to note that on page 549 of your issue of March 30th I have been misquoted as having stated in a discussion on Mr. H. G. Brown's paper before the Royal Society of Arts on the above subject that the Exide battery gave a better figure than the 75 per cent. efficiency that had been mentioned for the lead-acid battery.

No such statement was made by me. The point to which I took exception is one which I note you have abstracted, *viz.*, "At the present time a reasonable expectation of life for a submarine cell is about five years." As the subject of the paper was "The Lead-Acid Storage Cell," I contended that in a statement of this nature Mr. Brown should include all types of lead-acid cells, and the life of the Exide-Ironclad battery in submarine service is at least eight years, though many are still in use after ten years' service.

E. C. McKinnon.

Clifton Junction, *April 2nd*, 1928.

The Durability of Cables.

I send you herewith a piece of cable of Henley's manufacture, which was installed in some warehouses in the Commercial Road, now belonging to the Port of London Authority, in 1887, and removed in 1925 because of structural alterations.

After a period of 38 years the cable was working quite satisfactorily and is in excellent condition. Its specification is 19/11 s.w.g. plain copper wire, one coat of 1¼ in. tape, treated with wax and resin compound, dielectric of black unvulcanised rubber, taped with rubber-proofed tape, served with jute, Stockholm tarred and compounded.

W. A. Moore,
W. T. Henley's Telegraph Works Co., Ltd.
London, *April 3rd*, 1928.

[The sample certainly appears to be in excellent condition, and suggests that the cable might be good for another 38 years' similar service.—EDS. ELEC. REV.]

Capital Charges.

I thank you for giving me, through the medium of your correspondence column the manner in which the cost of standardisation of frequency is to be met. This makes matters quite clear. It is perhaps a little hard on the 50-period undertakings, which have nothing to gain, but I appreciate that in a national matter of this description, the fortunate ones must be prepared to make some sacrifice for the less fortunate. It occurs to me that it will be a little hard on those progressive undertakings which have already spent their own money in making their own supply conform to standard, if they are now to be called upon for a levy to deal with the conversion of other stations, but possibly special arrangements will be made in such cases. The natural sequence to this method of procedure would appear to be that, when a bulk supply is available, it should be at the same price to any authorised undertaking, irrespective of the geographical position. I wonder whether this is likely to be so?

H. Wilson.

Ashford Electricity Works,
April 2nd, 1928.

Will "Jehu" please send his name and address for our information?—EDS. ELEC. REV.

Legal.

Theft from Prepayment Meter.

JAMES STUPART, 9, Houldsworth Street, Blairhall, was charged recently at Dunfermline Sheriff Court with having forced open the drawer of a prepayment electricity meter and stolen 25s. An agent for the accused, who pleaded guilty, stated that the meter was not sealed when it came to the house. When the man came to collect the money accused offered to pay the 25s., which was the value of the electric light which he had stolen. The Sheriff imposed a fine of £3, with the alternative of twenty days' imprisonment.

British Thomson-Houston Co., Ltd., v. Wineman.

BEFORE Mr. Justice Astbury, in the Chancery Division, on April 3rd, the British Thomson-Houston Co., Ltd., sued Mr. Bernard Wineman and his son, David, of White Lion Street, Whitechapel, E., seeking an injunction to restrain infringement by them of the company's patents for leading-in wires and gasfilled lamps, with delivery up of infringing articles and damages. The elder defendant stated that the parcel sent to the address of a caller was a transaction by the son, a minor, and was without the father's knowledge and consent. Infringement was not denied.

Mr. W. TREVOR WATSON, for the plaintiffs, said that, as his Lordship knew, there was a large illicit trade in these lamps and all kinds of devices were employed—sometimes the defendant carried on as a limited company with no capital, of which he was the director, sometimes he carried on under the name of his wife, but here was the unusual case of a defendant sheltering behind his infant son.

Mr. HARRY HODGSON, of Blackpool, lamp importer, stated that at the defendant's premises in Bishopsgate, he asked for gasfilled "non-ring" lamps. The father said he could sell gasfilled lamps, and asked witness to call next day. He did so and saw the son, who said the business was his and not the father's. Later, witness asked for 100-W lamps and 60-W gasfilled lamps; the father produced a parcel and said: "I would like to send these samples to your private address. I shall then know that you come from Blackpool and are not a spy from the 'ring'." David Wineman made out the invoice, and the lamps, half a dozen of each, were sent to Blackpool. For the last six months witness's sole occupation had been giving trap orders.

The elder defendant, in the witness-box, said he came from Switzerland and dealt in silk and lamps from Austria and Holland. His son was a student and not in the business. Witness did not tell Mr. Hodgson that he could supply gasfilled lamps; he said he could not. He sold metal-filament lamps at 6d. each and radio valves and switches. He was present only when Mr. Hodgson called at his first visit.

Answering his Lordship, witness said he sold from 100,000 to 150,000 non-gasfilled lamps a year. He knew the sale of unlicensed gasfilled lamps was illegal. He told Mr. Hodgson to call again because Hodgson was considering his price for ordinary lamps. Witness received a consignment of nine cases of gasfilled lamps on October 28th, 1926, for Johannesburg.

His LORDSHIP: And how many other consignments for Africa?—Possibly three or four.

The younger defendant said that Hodgson persuaded him to make a few shillings by getting lamps, and witness replied that all must be in confidence and without his father's knowledge. His father was not present when he got Hodgson the lamps. His father had not told him not to sell gasfilled lamps and he did not know it was wrong.

Mr. JUSTICE ASTBURY granted the injunction asked for, with delivery up, costs, and an inquiry as to damages, and made the order against the father and included the son in the injunction. He said he was satisfied that the defendants had told a tissue of lies.

Theft of Radio Goods.

AT Old Street, on April 3rd, Thomas Wybrow, motor driver, Hackney Road, and James F. Murray, painter's labourer, Finsbury, were charged on remand with being concerned with two other men in stealing 24 valves and other radio apparatus, valued at £29, the property of Messrs. Peto Scott & Co., from their warehouse at Finsbury.

Detective-Sergt. CORY said that the men had pleaded guilty the previous week. Wybrow was the prime mover in the affair, and still refused to give any information as to where the property had gone. Murray had been in trouble before, but not recently.

Mr. CLARKE HALL sentenced Murray to four months in the second division, and Wybrow to three months' hard labour.

Reviews.

Diesel Engines for Land and Marine Work. By A. P. CHALKLEY, B.Sc. (Lond.), A.M.Inst.C.E. Sixth Edition. Pp. 320; figs. 196. London: Constable & Co., Ltd. Price 24s. net.

Chalkley's book on Diesel engines is probably the best known of the many which have appeared on this subject in recent years. The book was first published in 1912, and has now attained the dignity of a sixth edition, but as the fifth edition appeared more than five years ago, it is apparent, when the almost phenomenal development of the Diesel engine during the past few years is considered, that the new edition has not appeared a moment too soon. It is always a difficult matter, particularly in the face of many fundamental changes, to bring a text-book up to date on the appearance of a new edition, but it must be admitted, with one very important reservation, that Mr. Chalkley has succeeded in his difficult task. The one reservation which we feel compelled to make is that consequent, no doubt, upon his connection with the marine side of his subject, he has tended to overlook the important progress which has been made in the development of land types of Diesel engine for driving electrical generators and to confine his attention far too exclusively to the developments which have taken place in the application of the Diesel engine to the propulsion of ships.

The land-type heavy oil engine as required for the driving of electrical generators must in many respects differ from the marine type. In the first place, it does not require any reversing and manœuvring gear such as forms an essential feature of a ship's engine, neither is it necessary to design the fuel pumps and valves so that the engine can be run at low speeds. Secondly, the land engine is a constant-speed engine, and the most sensitive governor is demanded, particularly if it is direct-coupled to an alternating current generator which has to run in parallel with other units. Another almost fundamental difference between the land engine and the marine engine is that of economic speed of rotation. The marine type may rightly be called a low-speed engine, since it has to run at a speed which will permit of its being direct-coupled to the propeller shaft, and for maximum propulsive efficiency the speed of the propeller must be in the region of about 100 revolutions per minute, depending upon the speed of the ship. For land purposes the adoption of far higher speeds, say, in the region of 350 revolutions per minute, permits of a far lighter and smaller engine, and since the cost of a machine varies more or less in accordance with its weight, it is to be presumed that once the difficulties of initial construction have been overcome, the cost will therefore be substantially less. These are some of the phases of the problem upon which Mr. Chalkley only touches in the most cursory manner, but which, of course, demand very complete investigation if the comprehensive title of the book is to be justified. Similarly, too, of the seven chapters dealing with the construction of Diesel engines, five are expressly devoted to marine types, while the other two contain quite as much matter relating to marine designs as to those for use on land.

In spite of this shortcoming, we can recommend the book to all who are interested in the design and construction of Diesel engines; the clever designer who is aware of the peculiar requirements of a land-type engine will be capable, where necessary, of modifying the various details to suit his own purposes. Various new designs of double-acting engine, using either the four-stroke or the two-stroke cycle, are included. Mention is made of the 15,000-b.h.p. M.A.N. engine installed at the Hamburg Electricity Works, and the trial results of this engine are given, but we should have liked to see detailed drawings of some of the Diesel engines which have recently been installed in various power stations in these islands.

The book is very well produced, and the drawings are, almost without exception, very clear.

Electrical Power Transmission: Principles of Design and Performance. By E. A. LOEW, Professor of Electrical Engineering. Pp. xiii+388; figs. 105. London: McGraw-Hill Publishing Co., Ltd. Price 20s. net.

This book is not intended to discuss details of a practical nature, which are learnt by practical experience in the field or found in manufacturers' publications. In a clear and masterly manner the book commences with an instructive chapter on complex quantities, then the mechanical and electrical features and the question of economics are broadly discussed. Differing from nearly all other books on this subject, it treats at great length of the mechanical and electrical problems, and it sets out a complete theory covering the whole problem from start to finish. The book is an American publication and it represents the work of a master; the British engineer and student requiring the best mathematical tools underlying the theory of large power transmission lines, such as the 132,000-volt main transmission on the verge of development in this country, cannot do better than have a copy of this work on his shelf. Much of the material is the substance of a University course in transmission line theory and design given during the last ten years to senior and graduate students in electrical engineering—this being excellent recommendation in itself. The electrical portion deals with design of the larger overhead power transmission lines for voltages at and above 60,000 V. The rigorous or exact methods in hyperbolic and convergent series forms are discussed, the former method occupying the text.

In the discussion of the most economical voltage and conductor diameter, Prof. Loew endeavours to prove that, per unit length of line and for a given frequency, the inductive reactance and susceptance are both practically independent of the diameter of conductor used, provided the altitude and the conductor roughness do not alter, and that the operating voltage is always a constant percentage of the critical disruptive voltage. In practice, these factors do vary in different measure in different parts of a line, and, as rigorous methods of calculation are used, there is the question of relative exactness of this statement and the true constants per unit length of line, &c., for a given diameter of conductor, this latter being the usual method of calculation. His method is novel and instructive.

In the chapter on line design and performance there is a conspicuous absence of the steel-reinforced aluminium conductor comparison. In the University of Washington Engineering Experimental Station, Bull. No. 32, quoted by Prof. Loew on page 240, he gives what would appear to be conclusive proof of the advantages of copper over higher strength conductors. This book would have added value with Prof. Loew's solution of the steel-reinforced-aluminium comparison.

Excluding the Appendix, the book contains 16 chapters covering some 333 pages, or 385 pages in all. The first seven chapters discuss the electric circuit theory, and the last seven chapters discuss the mechanical features of line design. The chapter headings are: Complex Numbers—Circular and Hyperbolic Functions; Properties of Transmission Line Conductors; The Magnetic Circuit and Inductance; The Dielectric Circuit and Capacitance; Corona; Inductive Interference; Short Transmission-Line Calculations; Long Line Equations—Exact Solution; Voltage Control of Transmission Lines; Mechanical Design—Supports at Equal Elevation; Mechanical Design—Spans with Supports at Unequal Elevations; Economics of Span Design; The Most Economical Voltage and Conductor Diameter; Vector and Circular Diagrams of Line Performance; Power Limits of Transmission Lines; Example of Line Design and Performance Calculations; Appendix A to D giving useful tables. The print, paper, binding, form and colour typify the McGraw-Hill publications.

Wireless Principles and Practice. By L. S. PALMER, M.Sc., Ph.D., F.Inst.P., A.M.I.E.E. Pp. xi+504; figs. 307. London: Longmans, Green & Co., Ltd. Price 18s. net.

Textbooks on wireless which deal with practice in addition to principles become out of date so rapidly that there is always room for a new one if it is really up to date, as is the case with Mr. Palmer's "Wireless Principles and Practice." Mr. Palmer is the head of the department of Pure and Applied Physics in the Faculty of Technology of the Victoria University of Manchester, which ensures a full appreciation of the needs of students, and he was for some time a wireless engineer at the Naval Signal School at Portsmouth, which ensures his possession of a type of practical knowledge not always apparent in textbooks.

Wireless is now really too big a subject for its principles and practice to be covered comprehensively in one volume. Mr. Morecroft's latest edition of "Principles of Radio Communication" runs to 1,000 pages, and hardly touches practice. In fact, the time seems to have come when it might be useful to deal with the subject in two, or even three, separate aspects, *i.e.*, principles and practice, the latter being divided into technical and commercial practice. Most standard books, like the one under review, try to combine principles and technical practice with the result that they become out of date far too soon due to rapid changes in technical practice. None of them attempts to tackle commercial practice because the authors have not the necessary knowledge, and even if they had, the advances are so rapid that much of the matter would be out of date before it appeared in print.

Mr. Palmer's book combines principles and technical practice satisfactorily. He deals first with wave motion and the principles of high-frequency currents in some twenty pages which must be looked upon as a revision of the student's knowledge of those aspects of alternating-current work which are essential as a foundation for the study of radio technology. He then proceeds to deal with the whole subject in a clear and up-to-date manner. A fair amount of mathematical work is included, but much of it is so arranged that it may be omitted without losing the thread of the argument, and he successfully avoids overloading his text with historical details, both matters of importance in a book which is primarily intended for students. It will be found useful too as a book of reference, as it is provided with a good index, and an excellent bibliography at the end of each chapter. Altogether it should prove a valuable textbook for electrical engineers who wish to tackle this particular line, and for students who have already obtained a knowledge of the principles of electricity.

The Electrical Equipment of Automobiles. A Book of Principles for Motor Mechanics and Motorists. By STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M.Inst.C.E. Pp. ix+128; figs. 42. London: Chapman & Hall, Ltd. Price 5s. net

Despite the large number of books that have been published on the subject of the electrical equipment of motor vehicles, the author and his publishers evidently consider that there is still room for another, and we doubt not, in view of the practical character of the work, that it will meet with success. It is certainly a work that should appeal to the teachers of motor engineering subjects at polytechnics and technical institutions throughout the country, the principals of which are at present being urged to make better and increased provision for the technical education of young men to provide the ever-increasingly important motor repairing industry with expert workmen. Dr. Smith is Professor of Electrical Engineering at the Royal Technical College, Glasgow, and the present work is based on a series of lectures on the subject which he gave at the College during the winter of 1926-27 in response to requests from representatives of the motor trade in the Glasgow area.

Just as in the course of lectures referred to in the book before us, Dr. Smith has not addressed himself to the absolute novice in electrical matters, but has presumed his readers to possess a knowledge of the fundamental laws of electricity and magnetism. Despite this, in the first chapter he deals briefly, yet adequately, with the storage battery, its principles of working, charging and discharging, and with the care needed to keep accumulators in good working order. In connection with "topping up" by the usual addition of distilled water to the electrolyte, it is interesting to learn that in Glasgow tap water is quite satisfactory. Following a chapter on the fundamental principles of electric generators and motors, a special one is devoted to starting-motors in which the relative merits of the 6- and 12-volt systems are discussed, it being pointed out that to obtain the provision for the percentage voltage drop, the ampere-hour capacity of a 6-volt battery must be double that of a 12-volt set.

Every motor mechanic and motor owner knows from experience that in winter engines are more difficult to start than at other periods of the year. It is generally considered that this is due to the slower evaporation of the motor spirit which forms the basis of the engine fuel, and to the thickening of the lubricating oil. In view of the unusually severe climatic conditions recently experienced, a fact pointed out by Dr. Smith that extremely cold temperatures have also their effect on accumulators is of more than passing interest. Thus, he shows that in the case of a fully-charged battery discharging to start an engine, while there is a drop in the battery terminal voltage of 25 per cent. at a temperature of 60 deg. F., the drop is increased to 33 per cent. at a temperature of 32 deg. F., while if the battery has lost half its charge the drop is 50 per cent. at 32 deg. F. Since the current is proportional to the voltage and as, comparing the effects of the first and third of the above-mentioned cases, there may be only 50 per cent. of the voltage available in a cold winter, it is clear that the voltage may be insufficient to allow the starting motor to rotate the engine, the more so in that, with the thermometer indicating 32 deg. F., an engine may require a turning effort three times as great as when it is warm, to put it into operation. Thus, while it is important that a battery should never be discharged below the safe limits, it is extremely important that in winter and in un-

usually cold climates the cells should always be kept well charged.

Turning to the subject of the ignition of the explosive charge, Dr. Smith first gives an outline of the sequence of operations in a four-stroke engine "as used on autocars," and here, we think, a few lines might have been usefully included anent two-stroke engines, which, although mostly found on motor-cycles, are often taken into motor repairing establishments for attention to the ignition equipment. Subsequent sections of the chapter deal with the induction coil, the distributor, the contact breaker, battery-coil and magneto ignition, sparking plugs and ignition faults. In a final chapter wiring systems and fault location are equally lucidly dealt with.

The work is illustrated by about sixty drawings, including sections of the three principal types of magneto, and can, as already stated, be well recommended. If one were inclined to criticise, it would be to suggest that the author has perhaps adhered rather too rigidly to his purpose of dealing with fundamental principles, and that the usefulness of subsequent editions to engineering students would be increased by the addition to some notes on the peculiarities of certain largely used ignition devices, as well as lighting dynamos and starting motors—of which latter sectional illustrations like those of the magnetos might be included. We note, too, that Dr. Smith also deals with his subject as applied to four-cylinder engines only. Although the principle is the same, the increasing popularity of cars with six-, eight-, and even twelve-cylinder engines would seem to call for some reference to the differences, where they exist, particularly in connection with the ignition arrangements.

Wireless Direction Finding and Directional Reception. By R. Keen, B.Eng. (Hons.) Sheffield, A.M.I.E.E. Second and Enlarged Edition. Pp. iv+490; figs. 329. London: Iliffe & Sons, Ltd. Price 21s. net.

Directional wireless has assumed a most important aspect during the last couple of years, not only on account of its rapid application to navigational purposes, but also in connection with the beam system of working, which during the past year has changed the whole outlook of wireless communication from a commercial point of view. This is the second edition of Mr. Keen's "Direction and Position Finding by Wireless," which, published five years ago, has hitherto been recognised as the standard work on the subject in this country. Five years is a long period in wireless development, and in this particular branch the advances during the last five years have been very marked, especially in directional reception which has now been added to the book, as its title implies. Much of the first edition has been recast, and the chapter on the valve amplifier has been omitted altogether as the subject has become too complex for inclusion in the space available. The astronomical portion of the book has been rewritten and useful methods of finding the direction of true north have been added to it. The chapters on practical ship-and-shore installations and on faults and maintenance deal chiefly, as they did before, with the Bellini-Tosi system, just as Dr. Long's recent book on "Navigational Wireless" dealt chiefly with the working of rotating-frame systems.

It is generally recognised now that the receiving directional equipment of the new Marconi beam system is of outstanding importance, and we should have liked these arrangements to have been more fully described, and the same might be said of revolving beacons which are now coming under serious notice after many years of experimental obscurity. Much of this information, however, is still no doubt unavailable for publication.

Mr. Keen deals comprehensively and clearly with the whole subject in an authoritative manner. The latest theories and their practical applications are described with accuracy and a wealth of illustration. An excellent bibliography, which must surely include every paper of any importance on the subject, with textual references, is included, as well as a satisfactory index.

This is a really good book, the best we know of on the subject as a whole, and one which nobody who is at all interested in the subject can afford to omit from his shelf.

The A.C. Commutator Motor. By C. W. Olliver. Pp. xi+231; figs. 184. London: Chapman & Hall, Ltd. Price 21s. net.

The subject of this book is a somewhat peculiar one. A.c. commutator motors were developed in the very early days of electrical engineering, and the enthusiasm with which various inventors entered the field and produced more and yet more variations and types has perhaps been without parallel in the history of the industry. Yet to-day the surviving a.c. commutator machines can almost be counted "on the fingers of one hand." Low efficiency and power factor, difficulties of construction, and, above all, bad commutation, have all in greater or lesser degree combined to condemn most a.c. commutator motors to virtual extinction. In their own definite and restricted field, however, certain types fulfil the conditions of service very successfully, as in single-phase railway traction, rolling mill and paper machine drives, &c. The author of the book under review seems to be an enthusiast for these machines, and considers that they have not received the attention that they deserve from those requiring variable-speed a.c. machines with good power factor. Certainly the commutator types have a very decided interest to students of electromagnetic machine theory, in that the function of the commutator is combined with the consideration of pulsating and rotating fields—a combination of the most generalised type.

In his opening introductory chapter the author discloses the scheme of the book and discusses some of the reasons for the neglect of a.c. commutator machines. This chapter—and, indeed, the book as a whole—shows in places a certain lack of cohesion and continuity. For example, the author repeats himself in almost identical terms on pp. 2 and 3, and commits himself to the unqualified statement that "motors of this type afford the best means of getting proper power-factor with an a.c. supply." He also remarks that "it can be confidently stated that any difficulties of this kind [*i.e.*, commutation] have been entirely overcome." We think that the author is unduly optimistic in this matter: those who have had anything to do with the design and manufacture of these machines—especially single-phase motors on normal frequency—will not be inclined to agree.

In Chapter II a mathematical analysis of commutation in d.c. and a.c. machines is presented. This is useful in realising some of the problems with which commutation is obscured, but is, as the author frankly recognises, mainly of academic value, and not capable of strict application in practice. All commutation theories, however, suffer from this drawback, and the question of accepting or rejecting such theories will rest usually with individual taste in such matters. It requires considerable courage to attempt to deal with this, one of the most intricate of problems met with in machine design, and further complicated due to the presence of a.c., but the author has adequately covered the ground and drawn his conclusions.

The next chapter deals with the theory of single-phase machines. A general treatment applicable to all types is given, but the matter appears to the uninitiated reader to be a little mixed, especially if the full significance of the adjectives "Latour," "repulsion," "compensated," &c., is not understood. Further, the term "compensated" is used to refer both to power-factor improvement and to the neutralisation of armature reaction—the latter term being confused on p. 60 with armature *reactance*. A legitimate criticism here is that the author plunges into his theory without giving the reader an adequate idea of the appearance and arrangement of the motors to which the theory is to be applied. A few more diagrams illustrative of the winding arrangements, &c., would have been of assistance. Three-phase motors are not treated analytically, it being stated that the single-phase analysis is equally applicable to the polyphase machines. The treatment is therefore mainly descriptive. Exception can sometimes be taken to the arrangement of the text: the Schrage motor, for example, is described under series and compound types instead of under shunt types, and no diagram of its connections is given, although it is quite the most promising of all the polyphase motors.

The author is much more at home with the treatment of cascaded sets and power-factor correction with which "Part I: Analytical" closes. This is a most satisfactory chapter, and we feel that here the author is on familiar ground. Part II deals with practical applications, and is very well done. The single-phase machines are used mainly in cranes and hoists, and on railways. It is perhaps unfortunate that the author so definitely exhibits his bias towards the single-phase system for railway electrification: he goes so far as to suggest that all communication circuits be removed from the railway tracks in order to remove one of the most serious objections to a.c. for traction! Much of the matter and illustrations in Chapter VII is drawn from a series of articles on "Main Line Railway Electrification," by Sir Philip Dawson and Professor S. Parker Smith, which has appeared recently in *The Engineer*.

Chapters VIII and IX are devoted in a most interesting manner to rolling-mill drives and general applications respectively. The whole of Part II is of excellent quality, and with certain alterations in presentation and arrangement Part I would be as good. There are a number of typographical errors and several captions are wrong or misplaced, making it appear that the proof revision did not receive sufficiently careful attention. The publishers have done their work well. The type, diagrams, and half-tone blocks are excellently printed on good paper.

Combined Lighting and Water Heating.

In connection with the new tariff which has been introduced by the Willesden District Council Electricity Department, providing a fixed charge for both lighting and water heating, special apparatus designed and protected by the chief electrical engineer, Mr. A. W. Blake, M.I.E.E., is being used. The water heater is fitted with three 80-W elements. All the lighting load passes through two specially designed electromagnetic relays which are so arranged that when the lighting load is *nil* or very small, all the water-heater elements are in circuit. At above 40- and 100-W lighting load the first and second of the water-heater elements respectively are cut out of circuit, to be put in again as the load falls to below the "cut-out" points. The third element of the water heater is always in circuit, but when the lighting load exceeds 160 W, a main current limiter indicates that it must be reduced.

D

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

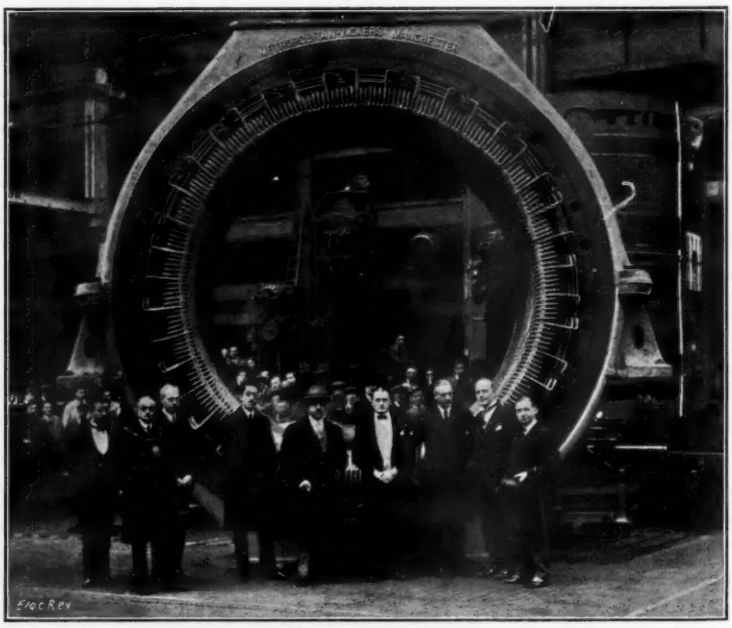
A Birmingham All-Electric House.

The accompanying picture is a view of one of the rooms of the recently-opened all-electric house at Stechford. The scheme was carried out by the Birmingham Electric Supply Department in conjunction with the local E.D.A. Circle. Local contractors are co-operating in advertising the house to the public.

The All-Electric House, Stechford.

The Afghan King at Trafford Park.

As we briefly mentioned in our last issue, the King of Afghanistan recently paid a visit to the Trafford Park works of the Metropolitan-Vickers Electrical Co., Ltd. The King was accompanied by Sir Francis Humphries, K.B.E., British Minister at the Court of Afghanistan, the Lord Mayor of Manchester (Councillor W. Davy), and other civic officials. On arrival at the works the visitors were received by Sir Philip Nash, K.C.M.G., chairman of the company. Other directors, Mr. Bernard Dudley Docker (deputy-chairman), Mr. G. E. Bailey, Mr. A. McKinstry, and Mr. J. S. Peck, were presented. The products seen in course of manufacture included turbines and steam power plant auxiliaries, large electrical machines, and a large variety of switchgear. The accompanying illustration shows the King and other members of the party beside the stator of one of the 20,000-kVA water-wheel alternators which are being supplied for the new Waikaremoana power station, New Zealand. The turbo-alternator sets inspected included units up to 45,000-kW capacity, the generators of these sets being the largest single units which have yet been built in this country. In the mechanical aisle one of the 20,000-kW, 3,000-r.p.m. turbines for the new Portishead power station, Bristol, was seen with the top half of its casting removed to show the arrangement of the wheels and diaphragms. The King was also shown apparatus used for the study of electrical phenomena in high voltage apparatus and transmission lines, as well as domestic appliances, and lamps. As a souvenir of his visit the King was presented with a handsome floor-standard lamp in oxidised silver, with the royal arms cast on the pedestal, and an oxidised-silver table standard.



King Amanullah at the Met.-Vick. Works.

Engineering Advertising.

Some observations on the subject of engineering and electrical advertising were addressed to members of the Engineering Section of the Incorporated Society of British Advertisers, Ltd., at a recent luncheon presided over by Mr. Taffs, chairman of the Section, by Mr. W. E. Warrilow. Reference was made to the progress that had been made in technical advertising and to the change that the old conservative attitude toward it was undergoing. The speaker thought that the agitation among technical advertisers was directed too much towards the disclosure of figures and not sufficiently to quality, but he found a tendency to greater frankness on the part of publishers. As electrical manufacturers and readers know, we welcome an interest on the part of advertisers in regard to both number and quality of circulation.

New Italian Company.

A new company has recently been organised in Milan, with a capital of 100,000 lire and the title La Società Elettrica Italo-Albanese, to establish generating stations in Albania.

Rates and the Engineering Industry.

The Engineering and Allied Employers' Federation has prepared a memorandum entitled "The Burden of Local Taxation," in which the disastrous effects of rates upon industry are dealt with. It is claimed that industry contributes directly a quarter of the total rates of Great Britain, and it is shown that the aggregate amount of rates levied in this country has risen from £79,000,000 in 1914 to £166,000,000 in 1926, or, *per capita*, from £1 17s. 10d. to £3 15s. 10d., an increase of just over 100 per cent. The memorandum states that about a third of the local rates are spent on Poor Law relief, double the proportion so expended in 1914. National insurance is also dealt with, it being shown that before the war the annual amount paid by employers and employed was about £1,600,000, whereas in 1924-25 the total was £36,700,000, in addition to £13,000,000 contributed by the State. The effects of these burdens upon production costs and selling prices are considered to be very serious. It would appear that 9 or 10 per cent. of the selling price of engineering products is accounted for by local rates and social charges added stage by stage from the raw material through to the final processes. The study leads up to a proposal that a Royal Commission should be appointed to inquire into the nature and causes of the unemployment which is the chief factor responsible for the burden, and it is also suggested that steps should be taken to deal with the debt borne by the State and local authorities in respect of the Unemployment Insurance Fund and advances made in respect of poor relief.

Industrial Design Competition.

The public exhibition of works sent in for this year's Competition of Industrial Designs will be held in the Exhibition Pavilion of the Imperial Institute, South Kensington, S.W. Full particulars of the scholarships and prizes offered in connection with the competition can be obtained from the Secretary of the Royal Society of Arts, Adelphi, W.C.2. Applications for forms of entry, labels, and instructions must be sent to him between May 1st and 12th. The accepted designs will be exhibited during August.

A Bright Installation.

The premises seen in the picture reproduced herewith are those of Messrs. Smarts, Portsmouth; the effective illumination was carried out by Messrs. E. Wolf & Co., Portsmouth, with "Kandem" fittings (Korting & Mathiesen Electrical, Ltd.). In the display windows reflectors fitted with 100-W gasfilled lamps are employed, and the interior is lighted by means of

Shop-window and Flood-lighting at Portsmouth.

"Kandem" one-piece units with similar lamps. The upper part of the building is floodlighted by three "Kandem" projectors, each embodying a silvered glass mirror reflector. Two of them employ 500-W gasfilled lamps, while in the other a 1,000-W lamp is fitted. The result, as can be judged from the picture, is most effective.

Anglo-Italian Industrial Conference.

British Industries states that a number of representatives of the Federation of British Industries will meet the General Fascist Federation of Italian Industries in Rome on April 16th and 17th. The British delegates will include Lord Gainford, Col. F. V. Willey, and three representatives of the Mining Association of Great Britain. The subjects for discussion include the collection and exchange of industrial statistics, the control of international fairs and exhibitions, the exchange of information between the two bodies, and relations with the League of Nations and other international institutions.

The Machine Tool Exhibition.

The fourth Machine Tool and Engineering Exhibition is to be held at Olympia from September 5th to 22nd; the opening ceremony will be performed by the Rt. Hon. W. C. Bridgeman, M.P., First Lord of the Admiralty. The organisers (the Machine Tool Trades Association, 70, Victoria Street, S.W.1) state that the exhibition is being well advertised at home and abroad, and that practically all the ground floor space has been let and about half of the gallery. This represents about 50 per cent. more space than was occupied by the whole of the exhibits in 1924.

Consumers' Representatives on the East Midlands Board.

Considerable interest has been manifested in the election of representatives of large consumers to the East Midlands Electricity Board, there being many candidates from Notts, Derbyshire, Leicestershire and Staffordshire connected with commercial and industrial undertakings. The voting has resulted in the selection of Mr. Alfred Clark, of the British Celanese Co., of Spondon, near Derby, at whose extensive works electricity is being used in large volume, and Mr. Alfred Hewlett, of Cossall, near Ilkeston, who is associated with mining operations.

Social Event.

The A.T.M. Dramatic Society (Automatic Telephone Manufacturing Co., Ltd.) presented two short plays at the Balfour Institute, Liverpool, on March 28th. The plays selected, "Mr. Blatherwick's Diplomacy" and "Holed Out in One," afforded ample scope for the enthusiastic members of this promising young society and the performances indicated that good progress is being made. The A.T.M. Orchestral Society furnished the musical interludes.

Telephone Progress in Spain.

At a meeting of the Association of Supervising Electrical Engineers on April 4th, Mr. Frank Gill, M.Inst.C.E., delivered a lecture on "Spain," illustrated by a number of lantern slides. Mr. A. M. Sillar, the president of the Association, occupied the chair. Mr. Gill commenced by saying that he proposed to speak of his impressions formed during a stay in Spain from September, 1925, to February, 1927, and to refer in a limited manner to the electrical work upon which he was engaged during that period. In the course of his remarks he said that in 1924 the National Spanish Telephone Company was formed to control the telephone systems of the country, being conceded a monopoly by Royal Decree. Under the scheme, it had to equip, by August, 1929, nineteen towns with telephone systems, the work including the laying of cables, the erection of buildings, and the installation of subscribers' boards. As many as 1,800 people had been passed through schools to equip them for the work entailed, whilst some 14,000 people had been engaged. Over 500 places had been provided with telephone systems that had previously not been supplied. Mr. Gill said that the contracting business in Spain had presented serious difficulties. In one instance they had invited nine firms to tender, but only one had responded. Referring to the experience of a member of the Association who had been engaged upon electrical installation work in the buildings under the scheme, Mr. Gill said that that member had found that screwed conduit was not obtainable in Spain. It was to the honour of the Association that one of its members had introduced it into the country. In Spain the electric light fittings were of inferior make, mostly of local or German manufacture, and the speaker said that he would like to draw the attention of British manufacturers to that state of things. In December, 1926, the automatic telephone exchange in Madrid was opened, and on that occasion a record was set up for Europe of the longest telephone communication over one circuit. The building, housing the offices, &c., of the National Spanish Telephone Company in Madrid, which was at present in course of erection, would probably be superior to the building of any other telephone company in Europe; it would tower above other structures in Madrid. Now that Spain was equipped with one of the most up-to-date and efficient telephone systems in Europe, it would be very interesting to observe whether that would cause impatience with backward and out-of-date methods, such as were employed in agriculture, and would create a desire for greater efficiency all round. The audience was keenly interested in Mr. Gill's slides, which gave an excellent impression of the topography of the country, its ancient buildings and customs, and illustrated some of the telephone development that was proceeding. The meeting concluded with a vote of thanks to Mr. Gill.

The Société Rateau.

The registration of this company in Great Britain was mentioned in the "New Companies Registered" section of our issue of March 30th. It was there erroneously stated that the company was incorporated in France in 1923; actually the year of incorporation was 1903.

Telephone Cable Manufacturing in Czecho-Slovakia.

The Ministry of Posts of Czecho-Slovakia has sanctioned the inclusion of the Siemens and Halske Company, which is represented by the Siemens Company, Prague, as a member of the Czecho-Slovak Distant Cable Construction Company of Prague. The participants in the latter have hitherto been the Krizik Company, the Pressburg Cable Works, the Kablo Company and the International Standard Electric Corporation, and its object is to extend the cable network in Czecho-Slovakia. The patents concerned are held by the Standard Electric Corporation and the Siemens Company.

Unemployment.

The Ministry of Labour returns for the week ended March 26th showed that the number of registered unemployed decreased by 32,280 during the week to 1,033,800. The total on the corresponding date of last year was 1,081,730.

Recent Contracts.

Orders have been placed with the BRITISH THOMSON-HOUSTON CO., LTD., Rugby, by the Metropolitan Electric Tramways Co., Ltd., for 122 traction motors of 50-h.p. rating, and by the Dublin United Tramways Co., Ltd., for 40 traction motors of 35-h.p. rating. These are repeat orders, the Metropolitan Tramways Company having ordered a total of 214 B.T.-H. traction motors of the same type.

MESSRS. STUART TURNER, LTD., Henley-on-Thames, have received from the Post Office an order for two 1½-kW battery-charging sets for two new automatic telephone exchanges in Essex, one being supplied to run on petrol and the other on gas.

Messrs. PETTERS, LTD., Ipswich, have received an order from Sharqieh, Ltd., for a 70-b.h.p. generating set to be installed in the new palace of the King of Hedjaz, which is being erected at Mecca, for lighting and power purposes.

It is reported that a large order has been placed by an Illinois coal-mining group for electrically-operated excavators with the Marion Steam Shovel Co., which is associated with Messrs. RANSOMES & RAPIER, LTD., Ipswich. The value of the order is in the neighbourhood of $2,000,000.

Trade Announcements.

The sales organisation of Messrs. NEWTONS OF TAUNTON will be transferred to the address of their present London office, 224, Shaftesbury Avenue, W.C.2, from May 1st. Telephone: Regent 8033. Telegraphic address: "Guidepost, Westcent."

Messrs. R. H. H. RASTALL & Co., LTD., Walmer Works, St. Stephen's Street, Birmingham, state that they have taken over the Efficiency Lamp Shade Co.'s business and are now sole manufacturers. They have sent us an illustrated list of their products.

The BASTIAN METER CO., LTD., is moving to larger and more modern works on the Slough Trading Estate, Bucks. It hopes to change over from its present works in a very short time, so as to reduce delays in deliveries to a minimum.

To cope with expanding business, Messrs. JOHN BENNIE, LTD., lift makers, &c., 149-155, Moncur Street, Calton, Glasgow, have opened branch offices in Belfast, Liverpool, Aberdeen, Newcastle, and Birmingham.

The UNIVERSAL ELECTRIC LAMP CO., 89, Great Eastern Street, E.C.2, has opened a department to deal with electrical accessories under the management of Mr. H. G. Baker.

Messrs. JULIUS SAX & CO., LTD., have moved their works and offices to riverside premises, with a wharf—formerly a residence of King Charles II. In future all communications should be addressed to "West Lodge," 27, Lower Mall, Hammersmith, W.6, and all goods should be consigned to "Aspen Place from Waterloo Street," King Street, Hammersmith.

New Catalogues and Lists.

THE SUN ELECTRICAL CO., LTD., 118 and 120, Charing Cross Road, W.C.2.—An illustrated and priced folder describing the "Sunshine" and "Goblin" vacuum cleaners and the "Duplex 75" floor polisher. It is accompanied by an offer of demonstration machines and supplies of overprinted pamphlets.

THE MACINTOSH CABLE CO., LTD., St. James's House, St. James's Street, S.W.1.—Booklet M.B.10, describing the construction and employment of the company's trailing cable, with notes on the "Williams-Rowley" earth-circuit protection system; and Booklet M.B.10A, containing instructions for the repair of the cable.

MESSRS. SANTON, LTD., Dock Street, Newport, Mon.—A series of illustrated and priced pamphlets dealing with the company's wash boilers, geysers, "multi-plugs," tank belts, service boards, &c.

BROOKHIRST SWITCHGEAR, LTD., Northgate Works, Chester.—A well-illustrated booklet dealing with the electrical control of printing machinery.

AUTOMATIC & ELECTRIC FURNACES, LTD., North Road, Holloway, N.7.—Heat Treatment Bulletin No. 39, "The Corrosion of Aluminium Alloys and How Corrosion is Affected by Heat Treatment," by E. G. Ritchie, D.Sc.; and an illustrated leaflet depicting examples of "Wild-Barfield" electric furnaces for the heat treatment of aluminium alloys.

EBONESTOS INSULATORS, LTD., Excelsior Works, Rollins Street, Canterbury Road, S.E.15.—A four-leaf blotter bearing a calendar for April and May and an illustration of an insulation-covered switch.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD., 170, Piccadilly, W.1.—A fully-illustrated catalogue of pneumatic tools and appliances.

MESSRS. BERNARD HOLLAND & Co., 17, Victoria Street, S.W.1.—List No. H101c containing illustrations and particulars of rotary air compressors and vacuum pumps.

MESSRS. FREDERICK BRABY & Co., LTD., Petershill Road, Glasgow.—Two illustrated lists of barrows, and steel constructional fittings.

MESSRS. PHILLIPS & TURNER, Cambridge Street, Birmingham.—An illustrated list of tinned brass cable clips and saddles.

METRO-VICK SUPPLIES, LTD., Trafford Park, Manchester.—Two illustrated folders, arranged for overprinting. M.S.4,629, dealing with the company's vacuum cleaners and floor polishers, and No. 4,637, with the "Met-Vick" electric washer and wringer. Priced.

THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester.—Circular No. 1,426/1, a profusely-illustrated publication describing in some detail the design, construction and testing of the company's turbo-alternators. The company has sent us a revised index of its catalogue, together with a large number of new and revised leaflets dealing with many departments of the company's work.

MESSRS. A. REYROLLE & Co., LTD., Hebburn-on-Tyne.—Publications No. 566/8-25, describing single-switch sub-stations; and No. 724/2-28, containing illustrated particulars of e.h.p. outdoor sub-station switchgear installations.

MESSRS. HOPKINSONS, LTD., Britannia Works, Huddersfield.—List No. 2,340, containing fully illustrated particulars of the company's steam traps; and List No. 2,240, describing "Duo" feed-water regulators.

MESSRS. B. & F. CARTER & Co., Lark Works, Rochdale.—A 20-page catalogue of plaiting and braiding machines for employment in various industries. Fully illustrated.

THE DRAYTON REGULATOR & INSTRUMENT CO., LTD., West Drayton, Middlesex.—An illustrated booklet describing in detail the company's pressure- and temperature-operated switches. Priced.

CRYSELCO, LTD., Kempston Works, Bedford.—An attractive booklet dealing with the manufacture and employment of "Cryselco" lamps.

Bankruptcy Proceedings.

E. O. HENSTOCK, electrical engineer, 21, Old Road, Brampton, Chesterfield.—Bankrupt's discharge suspended for three months until June 9th, 1928.

L. WINTLE, electrical engineer, 27, Stafford Street, Market Drayton.—Trustee, Mr. J. D. Turner, 12, Lonsdale Street, Stoke-on-Trent, released March 26th.

A. J. GARROD, manufacturer of wireless valves, sets and parts, Whitehorse Place, Wellingborough.—Last day for proofs for dividend, April 21st. Trustee, Mr. P. R. E. Smith, Church Street, Wellingborough.

P. CHESHIRE (P. Cheshire & Co.), electrical engineer and contractor).—First and final dividend of 6¾d. in the £ payable at the Official Receiver's office, Byrom Street, Manchester.

Company Liquidations.

GENERAL RADIO CO., LTD., 235, Regent Street, W.1.—A conference of the principal creditors was held recently. Mr. P. S. Booth, Kimberley House, Holborn Viaduct, E.C., acting on behalf of the largest creditors, stated that a receiver was appointed some time ago, and was carrying on the business. According to the books, the debentures totalled some £19,000, whilst the claims of the trade amounted to £50,000, and there were bills payable of nearly £24,000. The assets totalled approximately £156,000, and after deducting the debentures, there were net assets of £136,230, or a surplus of about £60,000, so far as the creditors were concerned. The company was registered in 1923 with a nominal capital of £30,000. The business had greatly increased since the formation of the company, and a factory was taken on a 21-year lease at £1,600 per annum. Premises were also acquired at Regent Street. The company had done a very extensive business on the hire-purchase system, the transactions being financed by a trust. A petition had been filed for the compulsory winding up of the company, but the Court had adjourned it. The creditors were asked to agree to a further adjournment. It was hoped that under negotiations now in progress arrangements could be made whereby the unsecured creditors would obtain payment in full within a reasonable period. The creditors recommended a further adjournment of the hearing of the petition for one month. A committee was also appointed consisting of the representatives of Messrs. Streets, Ltd., H. Yager, Ltd., Electrons, Ltd., Beko, Ltd., and H. Clarke & Co., Mr. A. Craig and Mr. H. King.

At an extraordinary meeting on March 30th, a resolution for the voluntary liquidation of the company was passed, and Mr. P. S. Booth was appointed liquidator.

The liquidator has given notice of a meeting of creditors at Caxton Hall, Westminster, S.W.1, on April 18th, and states that particulars of claims must be sent to him by May 12th.

BIRCHINGTON AND WESTGATE ELECTRIC LIGHT CO., LTD.—Winding up voluntarily. Liquidator, Mr. S. W. Marshall, 107a, Mortimer Street, Herne Bay.

MOULDENSITE, LTD.—A meeting of creditors is called for April 13th at 68, Victoria Street, S.W.

ELECTRICAL SUNLIGHT AND BERGONIE CO., LTD.—A meeting of creditors was called for April 12th at 54, Chancery Lane, W.C.

Dissolutions of Partnership.

DEVEREUX, MOODIE & Co., electrical and general engineers, 12 and 14, Eldon Lane, Newcastle-on-Tyne.—Messrs. H. P. Devereux and A. Moodie have dissolved partnership. Mr. Moodie will continue the business under the same style.

LEA & WARREN, electrical and heating engineers, Glenroy Works, Rockingham Road, Kettering, and 7, Victoria Street, S.W.—Mr. A. H. Lea and Mr. T. Marshall have dissolved partnership. Mr. Marshall will attend to debts and continue the business under the same style.

Private Arrangements.

BURNDEPT WIRELESS, LTD., Blackheath, S.E., and 15, Bedford Street, Strand, W.C.2.—As we briefly reported in our last issue, a meeting of creditors was held last week. At the annual meeting in December a committee of shareholders was

appointed to consult with the directors and the receiver in the preparation of a scheme. The chairman of the company, who presided, said that the committee of shareholders had prepared a scheme which it was thought would be acceptable.

Mr. Hamlyn, a member of the shareholders' committee, said that during the receivership the expenses had been curtailed, and for the period ended December 31st last the receiver was able to cover the expenses, and show a small surplus. The committee sought to find a means by which the company could be reconstructed with the goodwill of all parties. It finally decided upon a scheme under which £90,000 of new money would be raised by the shareholders, and the creditors offered 6 per cent. unsecured ten-year notes at the rate of 10s. in the £ for the amounts due to them. There would be a certain amount over on the paper value of the assets, and the shareholders might be given, say, 5s. shares, partly paid up. If the creditors were prepared to accept the scheme, the committee would go further in the matter. Either the company would be liquidated, in which case it was not thought that there would be anything for the creditors or for the shareholders, or they could adopt the scheme, and endeavour to carry through a reconstruction.

Mr. C. W. Rooke, receiver, said that during the first six months of 1927 there was a loss of £30,000. It was only fair to the late board to say that there were various contributory causes for which it was not responsible; there were very heavy overhead expenses which it could not get rid of. He, however, had been able to do so, as his appointment by the Court automatically terminated contracts. For the last six months of 1927, after paying the charges of the receivership, and providing for debenture interest on £90,000 of prior charges, there was a net profit of just under £2,500. The sales during the three months to the previous Saturday had been in excess of those for the corresponding period of last year. The company's present export trade was considerable, and it included countries where the busy radio season occurred during our summer. There was also a steady sale of portable receivers in the home market. The company had recently placed on the market an entirely new type of receiver, the sales of which had proved exceptional. If the scheme went through, there would be assets, free of prior charges, of a book value of about £150,000. If the creditors accepted the notes they would rank as unsecured creditors for £20,000 odd. If the creditors did not agree to the scheme, and liquidation took place, the second debenture holders might not be paid in full. With regard to a sale as a going concern, no one so far had offered a sum which would be sufficient to much more than cover the prior charges.

Mr. Hamlyn, replying to a question, said that the company would have the right to redeem the notes earlier if it was in a position to do so. The chairman said that there were first debentures for £40,894 held by the bank, and second debentures to the extent of £54,394 held by Johnson & Phillips, Ltd. An unsuccessful radio factory had been sold, and the shareholders would raise £90,000. The amount so obtained would allow of the debentures being paid off, and leave a small working capital. It had been thought advisable not to have any secured creditors under the scheme. They could not contemplate raising more than £90,000 of new money, and the company would not be left with a great deal of working capital. It might have about £10,000 of working capital, and might have to go to the bank. Mr. Rooke said that after negotiations, it had been possible to agree a figure with the Inland Revenue authorities, which was considerably less than the original amount—something like £18,000. The figure had now been agreed at only £3,500, of which £2,800 was preferential and £700 unsecured. The goodwill stood at £10,000.

Mr. Hamlyn said that they did not know yet whether the shareholders were prepared to find the £90,000. They believed that they could arrange for the underwriting of the scheme. If the creditors approved of the scheme, a meeting of the shareholders would be summoned.

A resolution was unanimously passed approving the proposed scheme in principle, and appointing a committee to represent the creditors. The committee consisted of the representatives of the Marconi Co., Siemens Bros. and Co., Ltd., Dubilier Condenser Co., Ltd., and the Old Ford Engineering Co.

An All-Electric Flat at Wimbledon.

The Wimbledon Electricity Committee, in conjunction with the Wimbledon Motor Works, Ltd., is arranging an all-electric flat at the company's new motor showrooms, Wimbledon Hill. It will be open to the public from April 23rd to 28th inclusive, and demonstrations will be given daily.

The Committee on Industry and Trade.

In pursuance of the plan adopted at the outset of its inquiry, this Committee has compiled for publication in advance of its report, a series of six preliminary volumes, of which four have already been published. The series is completed by two volumes now on the point of publication. The volumes are not concerned with recommendations, but aim at assembling, classifying, and analysing facts and tendencies with a view to providing a reliable basis for the discussion of the problems which confront British industry during the present years of change and crisis, and a sure foundation for action in the future. The first of these volumes was the "Survey of Overseas Markets," and it contained an account of the factors operating in overseas markets by which the development of British export trade is or may be affected. The second, "The Survey of Industrial Relations," published in March, 1926, was concerned with questions affecting the relations between the parties engaged in production. The remaining part of the Committee's inquiry is concerned with the factors affecting the efficiency and competitive power of British manufacturing and distributive enterprise so far as these factors operate in Great Britain. Volume III, published in February, 1927, under the title "Factors in Industrial and Commercial Efficiency," was concerned with certain factors in industrial and commercial efficiency and competitive power which seemed most suitable to be dealt with as a whole rather than in connection with the separate industries. Volume IV, entitled "Further Factors in Industrial and Commercial Efficiency," was published on April 3rd; it continues and concludes the series of general memoranda contained in the preceding volume, and we hope to deal with it in our next issue. Volumes V and VI, which are to be published shortly, contain a series of surveys of certain great exporting industries.

For Sale.

Mr. G. R. Lightfoot will sell by auction on April 18th, at 13, High Holborn, W.C., electric washing machines, vacuum cleaners, cables, accessories, &c. Leicester City Electricity Department has for disposal three surplus generating sets now at the Aylestone electric lighting station. Sheffield Corporation Tramways and Motors Department invites offers for a number of G.E.58 motors and B13 controllers. Manchester Electricity Committee invites offers for three synchronous motor generators. The City of Birmingham Electric Supply Department has for disposal d.c. generating plant. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction on May 3rd, at the Machinery Depôt of Vickers-Armstrong, Ltd., engineers' machine tools, electric motors, &c. Norwich Corporation Electricity Committee invites offers for one 750-kW Belliss-Crompton set and one 500-kW Parsons-Siemens turbo-generator. (See our advertisement pages to-day.)

Book Notices.

"New Ventures in Broadcasting." Pp. xvi+115; illustrated. London: British Broadcasting Corporation. Price 1s. —This study in adult education will be read with interest by all who are interested in the subject, for a big experiment is foreshadowed in the report of the Committee presided over by Sir Henry Hadow. The main proposal is that the B.B.C. shall associate with itself a National Council for Broadcast Adult Education, representing the many interests concerned from the listeners' side. It will exist not merely to give advice, but also to undertake the planning of the educational programme, together with growing responsibility for the supplementary work which accompanies the broadcast talks and lectures, such as the organisation of group listening.

"The China Year Book, 1928." Edited by H. G. W. Woodhead, C.B.E. (Editor of the *Peking and Tientsin Times*). Pp. 1,446. London: Simpkin, Marshall, Ltd. Price 42s. net. In spite of the disturbances in China during the past year or two, Mr. Woodhead has been successful in bringing out the annual edition of his useful compendium of information on China. The usual features are retained in an up-to-date form and an interesting account of Chinese affairs, supported by quotations from pronouncements by the various "leaders," forms probably the most interesting section of the work.

Scientific Paper of the U.S. Bureau of Standards. No. 569, "Generator for Audio Currents of Adjustable Frequency with Piezo-electric Stabilisation" (10 cents).

"Piles et Accumulateurs Electriques," by L. Jumau. Pp. ii+194; 76 figs. Paris: Libraire Arnaud Cohn. Price 9 fr.

"Automatic Telephony Simplified," by C. W. Brown. Pp. viii+165; figs. 81. London: Sir Isaac Pitman & Son, Ltd. Price 6s. net.

New Spanish Company.

A company has been formed in Barcelona, with a capital of one million pesetas and the title La Sociedad Electro-Magnetica Levane, to establish electric power stations.

United States Electrical Exports.

The exports of electrical equipment during 1927 from the United States were valued at $102,310,236, as compared with $98,495,245 in 1926. The principal contributions to this increase were made by accessories and parts for generators (from $919,823 to $2,012,196); flashlight batteries (from $1,674,309 to $2,250,397); fractional h.p. motors (from $1,999,877 to $2,613,915); flashlights (from $2,057,673 to $2,474,450); motor-driven household devices (from $1,743,677 to $2,311,940); and domestic washing machines (from $953,717 to $1,343,906). There were several large decreases, among them being steam turbo-generator sets (from $1,412,088 to $947,306); power transformers (from $2,230,743 to $1,555,915); switchboard panels (from $2,193,265 to $1,628,189); switches and circuit breakers over 10 A (from $2,618,212 to $1,986,902); railway electric locomotives (from $1,841,435 to $689,937); and telephone switchboards (from $2,218,550 to $727,367). The exports to European countries showed a general increase, notably those to Germany. Shipments to the United Kingdom (the largest European customer) rose from $6,777,531 to $7,153,086; the principal items were refrigerators, motor-driven domestic appliances, fractional h.p. motors, portable electric tools, and insulated copper wire and cable. The value of exports to India, Australia, and New Zealand declined, but there were increases in the instances of Canada and South Africa.

Nottingham Electrical Contractors' Dinner.

Mr. A. G. Turpin presided, on April 5th, at a dinner of the Nottingham branch of the Electrical Contractors' Association. The principal guest was the Mayor (Ald. E. Huntsman), who is chairman of the Corporation Electricity Committee and of the East Midlands Electricity Board. Referring to the Central England scheme, Ald. Huntsman said that as the scheme developed, Nottingham was destined to become one of the four basic stations upon which the scheme was founded. Electricity showrooms in connection with the Exchange buildings and shops were in course of construction; their primary object was to advertise the numerous uses of electricity. It had been suggested that if the showrooms did not pay, the Committee would enter into fierce competition with electrical contractors, but the latter need not be disturbed by that ill-founded apprehension. The showroom was not expected by him, at any rate, to pay; he viewed it as a part of their overhead charges. The Corporation committee desired to work with the contractors and not against them, and with goodwill on both sides he did not think that it was at all a difficult task. The toast of "The Electrical Contractors' Association" was proposed by Mr. H. Talbot, chief engineer of the Nottingham Electricity Department, and responded to by Mr. J. Orringe, chairman of the Midland section of the national organisation.

Danish Electrical Exports.

According to *Commerce Reports*, exports of electrical equipment from Denmark fell from 13,070,000 kr. in 1925 to 10,089,000 in 1926. The principal item, batteries and cells (including flashlights), fell in value from 6,389,000 kr. to 5,954,000 kr. The exports of cables declined in value from 1,051,000 kr. to 512,000 kr., and motors and dynamos from 2,737,000 kr. to 1,858,000 kr.

American Interests in Brazil.

The Times reports that American engineers have arrived in Brazil in order to found a large electrical power company, on behalf of a prominent combine in the United States.

Prices of Raw Materials.

Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, April 10th:—No change in copper and lead prices.

Messrs. Edward Till & Co. report, April 10th:—India-rubber, Para fine, 10½d., 2d. dec.

Lighting and Power Notes.

Australia.—Sydney.—Though there is no immediate danger of a shortage of electricity in Sydney, it is considered in official quarters that existing generating plant should be extended in order to provide for the future requirements of the city, and avoid what must be a shortage if the present rate of development in the metropolitan area continues. According to the *Sydney Morning Herald*, in a report made by Mr. Forbes Mackay, general manager of the City Electricity Department, to the City Commissioners, he recommends that steps be taken to meet the demand for power for 1932 and thereafter by making provision for extensions at Bunnerong and other generating stations. He states that unless something entirely unforeseen occurs, a shortage of electricity cannot occur in the areas supplied with electricity by the Municipal Council up to the year 1931. It would be prudent, however, to have additional generating plant ready to use at Bunnerong by the winter of 1932. This plant should be on order in the early part of the year 1929, and steps should be taken to invite tenders for extension plant at Bunnerong by about September, 1928, if Bunnerong is to be considered the source from which the additional supplies of electricity are to be drawn after the year 1931.

Bangor.—Electricity Supply.—The City Council has approved a scheme for the provision of h.p. mains in the city, at an ultimate cost of £16,554, with a first instalment for the mains, &c., to Port Penrhyn and Penrhyn Castle, at an expenditure of £4,883. At a meeting of the Council on April 4th, the Gas and Electricity Committee reported that the scheme had been sanctioned by the Electricity Commissioners, and the electrical engineer had recommended the Council to proceed forthwith with a portion of the second instalment, involving an expenditure of £4,214, and the provision of a sub-station at Farrar Road. The Council has approved the recommendation.

Blackburn. — Special Committee's Recommendations.—A special committee appointed to consider suggestions made by Mr. A. H. Dykes, the expert who investigated and reported upon the Electricity Department, has recommended that a special sub-committee of five members be appointed with a view to its becoming intimately acquainted with the work of the electricity undertaking. The question of new financial standing orders is under consideration, and will be brought forward for acceptance in the near future. The Electricity Committee was asked to consider proposals for increasing sales of electricity in the area, employment of canvassers, adopting assisted wiring schemes, maintenance schemes, development of showrooms, and the reading of gas and electricity meters by one inspector instead of two.

Bradford.—Loan Sanctioned.—The Corporation Electricity Committee has obtained sanction to the borrowing of £150,000, in respect of prospective unspecified expenditure on mains and services during the next three years.

Cambridge.—Institution Supply.—The Visitors of Foulbourn Mental Hospital, who proposed to install a generating station, have been informed by the Ministry of Health that a supply of electricity in bulk should be taken from the Bedfordshire, Cambridgeshire and Huntingdonshire Electricity Co. The estimated cost of the scheme is £23,347, with a standby, and £20,423, with no standby. The matter is to be referred to the consulting engineer, Mr. Collins, for his consideration, and tenders are to be obtained for the work.

Canada.—British Columbia.—The British Columbian Government has decided to take steps during the coming summer to determine definitely the water power resources of the Chilco River country, midway between Vancouver and Prince George, over which a water power reserve was placed a year ago. Water power of that locality has been estimated to be capable of development to the extent of 1,000,000 h.p., and a survey party is to be dispatched to the district to make scientific measurements and establish the exact potentialities. It is expected that it will take nearly three years to make a complete examination of the Chilco power situation.

A hydro-electric plant of unusual interest is about to be brought into operation in British Columbia. This is the Alouette plant of the British Columbia Electric Railway Co., which is adding 12,500 h.p. to the power system at a cost of $2,500,000. No operator will be needed, the single generator being controlled from the Stave Falls power house 11¼ miles away. Water which would ordinarily find its way down the Alouette River to the Fraser River is being diverted through a tunnel, driven 3,400 ft. under the mountain range, into Stave Lake. In this way the water will be used for power development at the Alouette plant, again at the Stave Falls plant, and later it will be used a third time, when the B.C. Electric's plant at the first canyon of Stave River is erected.

Hydro-Electric Development.—The Winnipeg correspondent of the *Financial Times* reports that the Winnipeg Electric Co. plans the immediate development of a 130,000-h.p. hydro-electric site at Seven Sisters, Winnipeg River. The cost of the scheme is $15,000,000. The Provincial Hydro-Electric Commission has signed a long-term contract with the company for a maximum of 30,000 h.p. to develop the use of electricity in the rural districts of Manitoba.

Chesterfield.—Electricity in Bulk.—The Corporation has agreed to take a bulk supply of electricity from the Derbyshire and Nottinghamshire Electric Power Co. for five years at £4 per kVA and 0.35d. per kWh metered, with a minimum payment of £4,020 for the first year and £4,800 per annum afterwards.

Continental.—Sweden.—Sydsvenska Kraftaktiebolaget is entertaining plans for the erection of a 100,000-h.p. generating station at Hinneryd, after the completion of the Karseforsen plant, thus concentrating all the water-power in the River Lagan, south of Vaernamo, in one plant by diverting the course of the river over 100 km. The water from the Lakes Furen and Flaaren would be conducted to Lake Vidoestern and thence to Lake Bolmen, whose water would be diverted through the River Torpa to Hinneryd, where the station would be constructed. — *Reuter's Trade Service* (Stockholm).

Switzerland.—According to a report recently presented to the Association Suisse des Electriciens by M. O. Ganguiller, the output of the generating stations in Switzerland, excluding that from plants having a capacity of less than 1,000 kW, amounted last year to 3,515 million kWh from directly supplied hydro-electric stations, 439½ million kWh from those supplied from storage lakes, and 1.7 million kWh from steam-operated plants, while 20.5 million kWh was "imported" from adjoining countries, giving a total of 3,976.7 million kWh, this not including the output from the State plants supplying power for the electrified sections of the Swiss Federal Railways.

East Ham.—Mains Extensions.—The Corporation Electricity Committee has authorised mains extensions at an estimated cost of £4,250.

Glasgow.—Appointment of New Manager.—The sub-committee of the Corporation Electricity Reorganisation Committee met on April 4th to consider the position of the general managership arising out of the resignation of Mr. R. B. Mitchell. After discussion it was agreed to advertise for a general manager who would have full control of the electricity department both in a technical and commercial sense. The salary which will be offered commences at £1,500 and rises to £2,000 per annum. The applications must be received by April 27th, and it is hoped that the new chief will take over his duties early in the next financial year, which begins on June 1st. Owing to the continued illness of Mr. Mitchell, the latter's formal resignation has not yet been received. The parent Committee is to meet to-day (Friday) when the first step may be taken in connection with the proposed reorganisation of the department, while consideration will also be given to the case of Mr. Mitchell.

Guildford.—ELECTRICITY SUPPLY.—At a recent meeting of the Corporation Electricity Committee the borough electrical engineer reported that he had received a number of inquiries for electricity supplies in Onslow Village. He had carefully investigated the matter, and estimated that the cost of carrying out extensions would be £3,200. He was authorised to canvass the district and ascertain the approximate return which would be made if the mains were so extended.

Halifax.—LOANS.—The Corporation is applying for sanction to borrow £24,334 for money spent on work of a capital nature and charged to "appropriation account" for the years ended March 31st, 1927, and March 31st, 1928, and £27,180 for prospective expenditure in respect of meters, services and apparatus for the ensuing three years. Application is also being made for sanction to loans of £10,344, the cost already incurred in changing over the electricity supply from d.c. to a.c. during the years 1926-27 and 1927-28, and £10,500 for prospective expenditure during the next three years in respect of the change-over.

Harrogate.—ELECTRICITY IN BULK.—In view of considerable extensions to its distribution area, the Corporation has asked Leeds Corporation for terms for a supply of electricity in bulk. Leeds Electricity Committee has recommended, subject to approval by the Electricity Commissioners and to securing powers to lay the necessary transmission line, that the Corporation should afford this supply.

Irish Free State.—THE LIFFEY TUNNEL.—The tunnel, measuring 800 ft. in length, and 7 ft. in diameter, sunk at a depth of 80 to 100 ft. under the River Liffey at the North Wall end, Dublin, has been completed by Sir R. McAlpine & Sons, and will soon be handed over to the Dublin City Commissioners. The work of laying the water mains, sewage pipes, and electric cables through it will be commenced shortly.

Liverpool.—LOANS SANCTIONED.—The Tramways and Electric Power and Lighting Committee has received sanction to the borrowing of the following loans: £11,824 for sub-station plant, buildings and mains; £27,530 for structural steelwork for the boiler house at Lister Drive power station; and £226,301 for sub-station plant and buildings.

London.—WANDSWORTH.—The Borough Council has received a communication from the Minister of Transport intimating that he proposes to consider the Council's letter of March 23rd as a formal application for the revision of the charges which the County of London Electric Supply Co. is authorised to make for electricity supplied under the Wandsworth Electric Lighting Order, 1892. The application is to be supplemented by further particulars from the Council.

BATTERSEA.—Cable extensions are to be carried out as follows:—Services, £1,246; private services, £1,109; public lighting, £633.

Maidstone.—MAINS EXTENSIONS.—The Town Council is to extend the mains to supply houses at Barming Heath, at an estimated cost of £1,325, and also to Bearsted Green, at an estimated cost of £770.

Manchuria.—MUKDEN.—In view of the increasing demand for electricity, the Mukden Electric Light Co., which has been in operation since 1908, is establishing a new station outside the North Gate of the city of Mukden, the necessary plant for which has been ordered in the United States. In order to encourage the use of electricity, the company runs a technical school with a three years' course in general subjects and one of two years in vocational study. Students are not only given free tuition, but also a small monthly allowance.

Preesall.—ELECTRICITY SUPPLY.—At a recent meeting of the Urban District Council reference was made to the scheme to supply electricity to the district by overhead cables. A letter was read from the engineer intimating that as the Electricity Commissioners had agreed to certain modifications in the regulations governing overhead supply, the capital cost of the scheme would be considerably reduced. The estimates showed the total amount required for next year to be £4,228.

Preston.—ELECTRICITY FINANCE.—At a meeting of the Corporation on March 29th, the chairman, in referring to the finances of the Electricity Department, said that receipts had advanced by £20,000 to £192,000, and working expenses were £10,000 less than in the preceding year. The accounts showed a surplus of £15,000 after paying loan charges. Up to date £1,400,000 had been spent on the department and £150,000 paid off. At least £200,000 should be set aside as a reserve for keeping plant up to date and to provide for replacements well within the loan period.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

REIGATE.—Lighting: Flat rate of 9d. per kWh. Power and heating: Flat rate of 3d. per kWh. Cooking: 1½d. per kWh, with a charge for heating reduced to 1½d. where an electric cooker is in use.

DORKING.—*Edmundsons' Electricity Corporation, Ltd.*—Lighting: From 10d. to 9d. per kWh. Heating: From 6d. to 3d. per kWh. Power: From 7d. to 3½d. per kWh.

NORTHWOOD.—*The Northwood Electric Light & Power Co., Ltd.*—Lighting: From 9d. to 8d. per kWh.

MAIDSTONE.—Lighting (business premises): From 7d. to 6½d. per kWh. Power: From £8 per kW, plus 1d. per kWh to £7 per kW, plus 1d. per kWh. Sewage works: From 1½d. to 1¼d. per kWh.

WORCESTER.—Lighting: A reduction of ½d. per kWh.

SURBITON.—*Callender's Cable and Construction Co., Ltd.*—Lighting: 6d. per kWh. Power and heating: 3d. per kWh.

SOUTHPORT.—Heating and cooking: From 1½d. to 1d. per kWh.

SUTTON COLDFIELD.—Lighting: From 6d., 5½d., and 4d. per kWh to 5½d., 5¼d., and 4d. Contract rate: From 15 per cent. of the rate value, plus 2½d. per kWh for the winter quarters, and 1½d. per kWh for the summer quarters, to 15 per cent. of the ratable value up to £45, and 12½ per cent. for over £45, plus 1½d. per kWh during the winter quarters and 1d. per kWh during the summer quarters, the new scale to apply only where electricity is used for lighting, heating, and cooking. Reduced scales are also recommended for heating, cooking, &c.

COLNE.—Lighting: (*a*) Prepayment meters, 7½d. per kWh; (*b*) ordinary meters, first 250 kWh per quarter 7d. per kWh, next 250 kWh 6¾d., over 500 kWh 6½d.; (*c*) a fixed charge of 3s. per quarter per 40-W lamp or its equivalent installed, plus 2d. per kWh. Ratable value system: A fixed charge of 20 per cent. of the ratable value, plus 1d. per kWh. Heating: First 50 kWh per quarter, 2½d. per kWh; all energy in excess of this amount, 1½d. per kWh. Power: Varying from 2½d. per kWh for the first 500 kWh per quarter to 1½d. per kWh for all energy in excess of 15,000 kWh.

Salford.—LOAN.—The Corporation Electricity Committee is applying for sanction to borrow £100,000 for mains and services in Salford and Prestwich.

Sheffield.—MAINS EXTENSIONS.—The Corporation Electricity Committee has authorised mains extensions at a cost of £5,824.

Skipton.—SPECIAL ORDER.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them authorising the Linton Mills Estate Co., Ltd., to supply electricity in part of the rural district of Skipton.

Southport.—NEW PLANT.—The Electricity Committee has considered the necessity of providing a new water-tube boiler, superheater, &c., for the electricity works, and has recommended the Council to approve an application for sanction to borrow £14,000.

Stafford.—LOAN.—Application is being made by the Corporation for sanction to a loan of £20,000 to cover prospective expenditure on mains, sub-stations, &c., for the three years ending March 31st, 1931.

Stone.—LOAN.—The Urban District Council has applied for sanction to borrow £22,500 for electricity purposes.

Torquay.—EXTENSION OF SUPPLY.—The Corporation Electricity Committee has authorised the engineer to proceed with the erection of the overhead line from Newton Abbot to supply the village of Ogwell, at an estimated cost of £1,419, including provision of sub-stations, switchgear, transformers, &c. The engineer has been authorised to provide a supply to Dainton and Whiddon, subject to guarantees for adequate minimum payment to cover the overhead charges in connection with the supplies being forthcoming.

United States.—ELECTRICAL DEVELOPMENT.—The Deep Water power station on the Delaware River, N.J., according to present plans, will be the first new plant designed entirely for 1,350-lb. boiler pressure. Four standard and two reheat 1,350-lb. pressure boilers will be supplied by the Babcock and Wilcox Company, each of which, with its steam economiser and air preheater, will produce 331,000 lb. of steam per hour at 725 deg. F. The two reheat boilers will deliver 290,000 lb. of steam per hour and will reheat 419,000 lb. of steam to 775 deg. F. According to *Power*, the initial capacity will be approximately 118,500 kW, and the ultimate capacity about 400,000 kW. Two 53,000-kW units, together with one 12,500-kW pressure unit, will be installed. This equipment is scheduled for delivery during May and June, 1929, and is the largest order of equipment designed to operate at this pressure which has ever been placed in the United States. The plant is owned jointly by the American Gas and Electric Company and the United Gas Improvement Company.

York.—"ALL-ELECTRIC" HOUSES.—The Corporation Housing Committee has recommended that the 50 houses to be erected on land adjoining Bad Bargain Lane be fitted as "all-electric" houses.

Tramway and Railway Notes.

Halifax.—TRACK IMPROVEMENTS.—The Tramways Committee has authorised the renewal of tramway track in Skircoat Moor Road, and the doubling of a section of the track, at an estimated cost of £1,700. The doubling is subject to Ministry of Transport sanction.

Hastings.—RAILLESS CARS.—A railless-car service was commenced on April 1st on an experimental section.

Plymouth.—NEW TYPE OF CAR.—A new type of car, sixteen of which are being built at the Corporation's own

works, has been introduced on the tramway system. This car carries a total of 72 passengers, 18 more than the capacity of any previous models. The inside seats are of the high-sprung mattress type, and covered in moquette, while, on top, tip-up leather chairs take the place of the former wooden seating. The panelling is in mahogany, and a new and improved system of lighting has been adopted, with two red lamps at the rear. The windows are of the saloon kind, and can be raised and lowered at will. Above each seat downstairs is a bell which the passenger may use to stop the car. The car is fitted with air brake equipment.

Preston.—Tramway Finance.—At the Corporation budget day meeting on March 29th, the chairman said the tramway showed an improvement in revenue of £3,644. There would be £5,000 for reserve, raising that fund to £26,000. Only £55,300 remained of the original capital debt of £206,000 on the undertaking, and it was a wise policy to build up a reserve and extinguish the debt as early as possible in view of the tendency to substitute motor-'buses for tramcars.

Prestwich.—Lease of Tramway.—At a recent meeting of the Urban District Council a letter was received from the general manager, Manchester Corporation Tramways, referring to the recent interview with representatives of the Council on the subject of the Manchester Corporation taking a lease of the Middleton Road section of the Prestwich tramway and confirming the terms offered for the lease at that interview, *viz.*: (1) the Corporation to undertake the maintenance and reconstruction of the track as and when required; (2) to provide a depreciation fund for such track after reconstruction to be handed over to the Prestwich Council at the termination of the lease unless it is renewed; (3) to pay a profit rental based on £100 per mile of single track per annum.

Telegraph and Telephone Notes.

Canada.—Radio Direction-Finding Stations.—The Dominion Government has authorised the construction of radio direction-finding stations in Hudson's Straits in order to aid navigation. Two will be built during the coming summer and two more in 1929, and will be ready for whatever traffic results from the completion of the Hudson's Bay railway terminal at Fort Churchill in 1930.

Dutch East Indies.—Radio Communication.—The Java Sugar Employers' Union has applied to the Dutch East Indies Government for permission to use wireless intercommunication between various factories and the Union's offices. The Government has appointed a commission to inquire into the subject.

Holland.—Transoceanic Telephony.—A recent demonstration of radio-telephone communication between The Hague and Batavia took place and is reported to have been most successful; conversations were carried on with perfect audibility in both directions, and voices could be readily recognised. Among those who attended the demonstration were Mynheer Plemp van Duiveland, of the Netherlands Foreign Office, and Mynheer M. H. Damme, director-general of Posts and Telegraphs.—*Reuter* (The Hague).

International Telephony.—Anglo-Danish Circuit.—A "through" circuit has been made available between London and Copenhagen, and a substantial reduction has been made in the price of the service between this country and Denmark.

Persia.—Radio Communication.—A new set of thermionic valves having been installed, the Teheran wireless station is again in working order and in communication with Beirut, Angora, and Kabul.

Switzerland.—Radio-telegraphy.—The Communications and Transit Commission of the League of Nations has completed its report on the proposal to establish at Geneva a radio-telegraph station powerful enough to enable the League to keep in touch with practically all its member States in times of crisis. It is estimated that the station would cost £50,000 to construct and £8,000 a year to maintain.

Radio Notes.

Australia.—Amalgamation.—The Commonwealth Government at a conference convened by the Prime Minister in Melbourne in November last invited the A-class broadcasting companies throughout Australia to endeavour to work out a scheme of co-operation and co-ordination of their services, and the Postmaster-General has since made a definite request that such a scheme should be proceeded with (see Elec. Rev., March 30th, p. 555). The directors of the two Sydney stations reviewed the New South Wales position after the Premier's hint, and negotiations between 2FC, Ltd., & Broadcasters (Sydney), Ltd. (2BL), which have since been proceeding with the object of taking the first step towards meeting the Government's wishes have been satisfactorily concluded.

Canada.—Wave-Lengths.—Canada's claim to more exclusive wavelengths is likely to be postponed in the event of the United States Federal Radio Commission's not receiving a further lease of life. Legally the Commission's authority expired on March 15th, and Congress appears disinclined to grant a renewal of that authority, says *World-Radio*. The Commission expects to get a special mandate from Mr. Herbert Hoover, Secretary of Commerce, to carry on its work until the transfer of its activities is made to the Department of Commerce. The most important Canadian claim now pending is that for an additional exclusive band for the use of the Manitoba Provincial Government's station; the Canadian authorities reminded the United States that Canada's claim stands for at least a dozen exclusive bands instead of the present six, and an increase in the number of shared wavelengths was also suggested.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the Electrical Review containing the advertisement is given in parentheses below.

Contracts Open.

Acton.—April 30th. Town Council. Switchboard for the Public Bath. (See this issue.)

Australia.—Sydney.—May 16th. N.S.W. Government Railways. One water-tube boiler and accessories for Zara Street power house, Newcastle. (Spec. 10s.)

July 18th. Six water-tube boilers and accessories for Ultimo power house. (Spec. £2.) Chief Electrical Engineer, 61, Hunter Street, Sydney, New South Wales.

Melbourne.—May 8th. P.M.G.'s Department. Standard resistances, condensers, &c. (B.X. 4274.)*

Barking.—May 15th. County of London Electric Supply Co., Ltd. Installation of electric lighting at the Barking power station extensions. (See this issue.)

Belgium.—May 3rd. Municipal authorities of Ixelles. Several sets of mercury rectifiers at one of the transformer stations. Particulars for 10 fr. from Service de l'Electricité, 20, Rue d'Alsace-Lorraine, Ixelles.

Biggleswade.—April 18th. Beds. E.C. Electric lighting installation at the school, cookery and manual instruction centres. County Surveyor, Shire Hall, Bedford.

Carlisle.—Electricity Department. L.c. and l.c.a. paper-insulated l.p. and h.p. cables. (See this issue.)

Clutton.—April 23rd. Board of Guardians. Electric lighting installation, Institution. Mr. I. Hood, engineer, 40, Queen's Road, Clifton, Bristol. (Returnable deposit of £2 2s.)

Colombia.—Bogota.—June 15th. Ministry of Posts and Telegraphs. 5,750 km. of telegraph line. (B.X. 4334.)*

Dundee.—April 27th. Electricity Department. D.c. and a.c. house service meters. (See this issue.)

Egypt.—Cairo.—May 17th. Ministry of the Interior. Two Diesel engine driven generating sets for Mansourah. (B.X. 4277.)*

Epsom.—April 17th. Electricity Department. Two 500-600-kW Diesel engine-driven alternators and accessories, e.h.p. and l.p. switchgear, one 500-kW rotary convertor, two sub-stations with transformers and switchgear, e.h.p. cable and laying, cooling tower, and fuel-oil storage tank. (March 30th.)

Fort William.—April 24th. North British Aluminium Co., Ltd. Structural steelwork for power house, &c., for the Lochaber water power scheme. Specifications from the company's offices, Adelaide House, E.C.4.

Glasgow.—June 4th. Trustees of the Clyde Navigation. Electric cantilever crane of 175 tons, 150 tons, and 130 tons lifting capacity, for Glasgow Harbour. Specifications and

forms of tender from Mr. Daniel Fife, mechanical engineer, 16, Robertson Street, Glasgow (three guineas deposit).
April 17th. Lighting Department. Materials, &c., for one year from June 1st next, including brass mountings, electrical fittings and accessories, lamp pillars, tin plate, copper, &c. Specifications, &c., from Office of Lighting Department, 20, Trongate.

Grimsby.—May 1st. Electricity Department. Boiler plant. (See this issue.)

Harrogate.—April 28th. Electricity Department. E.h.p., h.p., and l.p. switchgear, transformers, service meters, and service cutouts. (See this issue.)

Hull.—April 19th. Electricity Department. 33-kV overhead transmission line and outdoor switchgear. (March 30th.)
June 25th. Telephone Committee. One automatic telephone exchange (4,000 lines). (April 6th.)

India.—May 1st. India Store Department. Two Diesel locomotives for 5 ft. 6 in. gauge. Forms of tender (5s.) from the Store Department, Belvedere Road, S.E.1.
April 20th. 500-kVA transformers. (April 6th.)

London.—METROPOLITAN ASYLUMS BOARD.—April 18th. Installation of electric lighting on fire-escape stairs at the Northern Fever Hospital, Winchmore Hill; installation of electric bells at the hostel, Little Gray's Inn Lane, W.C.; and installation of a fire-alarm system at the Northern Fever Hospital. (April 6th.)
Installation of electric supply cable and switchgear between Joyce Green Hospital and Long Reach Smallpox Hospital, Dartford. (April 6th.)
H.M. OFFICE OF WORKS.—April 24th. Mechanical and electrical engineering labour in daywork in the Newcastle-on-Tyne, Leeds, and Southampton districts. (See this issue.)
BETHNAL GREEN.—April 24th. Board of Guardians. Extension of the internal telephone system at the Institution, Waterloo Road. (See this issue.)

Manchester.—April 18th. Waterworks Committee. Renewal of positive and negative plates in storage battery at Longdendale Works. (April 6th.)
May 2nd. Electricity Committee. Twelve months' supply of meters, cable, electric kettles, and potential and current transformers. (See this issue.)

Sidmouth.—April 14th. Gas and Electricity Works. 100 tons of fuel oil for semi-Diesel engines. (April 6th.)

South Africa.—JOHANNESBURG.—May 16th. Town Council. Switchgear and transformers. (B.X. 4284.)*
May 10th. South African Railways and Harbours. One electric passenger lift with dual control. (A.X. 6083.)*
May 18th. 6,600-V a.c. and 210-V d.c. switchgear. (B.X. 4294.)*
PRETORIA.—May 31st. Department of Posts and Telegraphs. Outdoor distribution boxes for 15-pair telephone cable and magneto and central battery switchboards. (B.X. 4324.)*

Southend-on-Sea.—April 30th. Corporation. One electrically-driven direct-coupled centrifugal pumping set for Eastern Valley pumping station. Specifications, &c. (£2), from Mr. R. H. Dyer, borough engineer and surveyor.
May 1st. Light Railways and Electricity Department. 1,500 current limiters. (See this issue.)

Stocksbridge (Yorks.).—April 17th. Electric lighting installation at Council school. Particulars from Education Department, County Hall, Wakefield.

Stoke-on-Trent.—May 9th. Electricity Department. One 12,500-kW turbo-alternator and condensing plant. (March 23rd.)

Swindon.—May 5th. Electricity Department. H.p. feed and l.p. pilot and other cables. (See this issue.)

Uruguay. — MONTEVIDEO. — May 3rd. State Electricity Works. One 75-kW Diesel-engine generating set, with accessories and spares. (B.X. 4270.)*
May 21st. H. and l.p. armoured cables. (B.X. 4301.)*

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Bradford.—Tramways Committee. Accepted:—
7,200 yards copper trolley wire (£420).—Collier Bros.
100 steel tires (£244).—Brown, Bayley's (Steelworks), Ltd.
17 sets upholstered tramcar seats for upper saloons (£6:0). Laycock Engineering Co., Ltd. 17 sets ditto, lower saloons (£776).—G. D. Peters & Co., Ltd.

Education Committee. Accepted:—
Electric light installation at Lidget Green School (£220).—A. R. Farrar & Co.

Watch Committee. Accepted:—
99 police call boxes (£2,599).—L. Mitchell & Co.

Crediton.—Board of Guardians. Accepted:—
Installation of electric light in the Poor Law Institution (£117).—H. Pincott & Sons.

Dewsbury.—Town Council. Accepted:—
1,500 yards of cable.—Power & Lighting, Ltd.

East Ham.—Tramways Committee. Recommended:—
Upholstered spring seats for tramcars (£24 per car set).—Messrs. Peters.

Electricity Committee. Recommended:—
Cable drum carrying trailer (£208).—Messrs. Carrimore.
Five-panel switchboard for Manor Park sub-station (£3?5).—New Switchgear Construction Co., Ltd.

Glasgow.—Electricity Committee. Recommended:—
250 10-amp. and 50 20-amp d.c. meters.—Chamberlain and Hookham, Ltd., and Ferranti, Ltd.

Guildford.—Water Committee. Recommended:—
Pumping machinery for waterworks (£9,637).—Rees-Roturbo Manufacturing Co., Ltd.

Hull.—Telephone Committee. Accepted:—
Wire (£102).—W. T. Henley's Telegraph Works Co., Ltd.

Liverpool.—Tramways and Electric Power and Lighting Committee. Recommended:—
Water-cooled arch for boiler at Lister Drive (£1,795).—Babcock & Wilcox, Ltd.
Nine a.c. and three d.c. Atritors (£1,076), two-speed gear in connection with fan motors (£1,042).—Metropolitan-Vickers Electrical Co., Ltd.
Extension of switchboards (£1,089).—Ferguson Pailin, Ltd.
Tramways Committee. Accepted:—
Welding tramway rail joints.—Rail Welding Co., Ltd., Mersey Welding Co., Ltd.
Tramway junctions.—Hadfields, Ltd., Edgar Allen & Co., Ltd., Titan Trackwork Co., Ltd.

London. — LONDON COUNTY COUNCIL. — Education Committee. Electric lighting at Brecknock School, St. Pancras:—

J. BRIGGS, ELECTRICAL CONTRACTORS, LTD. (Accepted.)	£579
Smethurst & Co. (London), Ltd.	660
A. Dean & Co., Ltd.	667
Griggs & Sons	678
Electrical Installations, Ltd.	681
British Electrical Installations Co.	762
Grierson, Ltd.	767
Barlow Bros. & Co.	795
Pinching & Walton	799
Locke & Soares	821
Ellis & Ward, Ltd.	880

Highways Committee. Pipework and feed pump in connection with the installation of new boilers at Greenwich power station:—

	Pipework, &c.	Feed Pump, &c.
JOHN SPENCER, LTD., GLOBE TUBE AND ENGINEERING WORKS. (Accepted.) ...	£8,418	£694
Stewarts & Lloyds, Ltd. ...	8,744	—
Brightside Foundry and Engineering Co., Ltd.	8,979	—
Le Bas Tube Co., Ltd.	10,713	—
Aiton & Co., Ltd.	10,811	—
J. P. HALL & SONS, LTD. (Accepted.)	—	651
Rees Roturbo Mfg. Co., Ltd. ...	—	687
W. H. Allen, Sons & Co., Ltd. ...	—	733
G. & J. Weir, Ltd.	—	783
Société Rateau	—	861

METROPOLITAN WATER BOARD.—Accepted:—
Electric motor-driven centrifugal pump at Hampton works (£159).—Harland Engineering Co., Ltd.
Electric motors and controls for replacement of engines at Hampton works by electric pumps (£313).—English Electric Co., Ltd.
Two automatically-operated control panels for Surbiton works (£78).—General Electric Co., Ltd.

METROPOLITAN ASYLUMS BOARD.—Installation of electric lighting, power and telephones at Caterham Mental Hospital:—

READ & PARTNERS, LTD. (Recommended.) ...	£8,395
T. Clarke & Co., Ltd.	8,600
H. Tattersall	9,320
Alpha Mfg. & Electrical Co., Ltd.	9,500
L. G. Tate & Co., Ltd.	9,678
Parker, Winder & Achurch, Ltd.	9,700
St. James' Electrical Co.	10,350
W. E. Hutchison	10,950
E. J. Britton & Sons	11,032
Power Contracts, Ltd.	11,318
D. Bentley (Leicester), Ltd.	19,000

Generating set for artificial sunlight apparatus, Goldie Leigh Homes:—

New Pelapone Engine Co., Ltd. (Recommended.)	£109
National Gas Engine Co., Ltd.	128
Keighley Gas & Oil Engine Co.	129
Petters, Ltd.	142
Arrol-Johnston & Aster Engineering Co., Ltd.	189
Alternatives, £155, £162 and £182	
J. H. Holmes & Co.	212
Alternatives, £123 and £152	

Installation of electrically-controlled stereophagus pump, penstock, &c., Head Office:—

Bilbie, Hobson & Co. (Recommended.)	£564
G. N. Haden & Sons, Ltd.	566
W. Griffiths, Sons & Cromwell, Ltd.	598
Fretwell Heating Co.	615
Pulsometer Engineering Co., Ltd.	630

Electric lighting new verandahs at Brook Hospital:—

Buchanan & Curwen. (Recommended)	£142
L. G. Tate & Co., Ltd.	160
T. Clarke & Co., Ltd.	180
Read & Partners, Ltd.	199
Toy & Winslow	195
Riddle & Goddard, Ltd.	215

Manchester.—Tramways Committee. Accepted:—
Tramcar motors.—General Electric Co., Ltd.
Tramcar motors and controllers.—British Thomson-Houston Co., Ltd.
Tramcar trucks.—Brush Electrical Engineering Co., Ltd.
Electricity Committee. Accepted:—
Electric wash boilers for 12 months.—A. Low & Sons, Ltd.; Jackson Electric Stove Co., Ltd.; Burnley Components, Ltd.; and Revo Electric Co., Ltd.
Rejointing of stator end connections of turbo-generator.—Metropolitan-Vickers Electrical Co., Ltd.
Alterations to coal bunkers.—Widnes Foundry, Ltd.
Low-pressure pipework, Stuart Street.—Brightside Foundry and Engineering Co., Ltd.
9,000-kVA static transformer for Dickinson Street sub-station.—English Electric Co., Ltd.
Two 1,500-kVA rotary convertors for Polygon and Chorlton sub-stations.—Electric Construction Co., Ltd.
One 2,500-kVA motor convertor for Greenwood Street sub-station.—Ateliers de Construction Electriques de Charleroi. One 1,000-kVA and one 750-kVA ditto for Longsight and Miles Platting sub-stations.—Crompton-Parkinson, Ltd.
33,000-V feeder cable.—Callender's Cable & Construction Co., Ltd.
Auxiliary pumps for Barton.—Mather & Platt, Ltd.

Nantwich.—Board of Guardians. Accepted:—
Installing electric lighting at the Institution (£1,293).—Martland & Co.

Oldham.—Electricity Committee. Accepted:—
Three 250-kVA transformers.—Metropolitan-Vickers Electrical Co., Ltd.
Three 1,000-kVA transformers and a.c. motors.—English Electric Co., Ltd.

Rotherham.—Board of Guardians. Accepted:—
Electrical sundries for six months.—Smith Bros., Ltd.

Salford.—Education Committee. Recommended:—
Electric lighting and power installation at John Street school (£270).—C. Doherty & Co.
Electricity Committee. Recommended:—
Erection of two "Liptak" flat double suspension arches for boiler at Agecroft power station (£402).—Liptak Furnace Arches, Ltd.

Sheffield.—Electric Supply Committee. Accepted:—
Reconstruction of twenty-four 200-volt transformers (£2,076).—British Electric Transformer Co., Ltd.
Additional sub-station switchgear (£9,070).—A. Reyrolle and Co., Ltd.
One 330-kW rectifier equipment, with switchgear (£1,994).—Hewittic Electric Co., Ltd.
Set of moving parts for coal conveyor at the Blackburn Meadows generating station (£490).—New Conveyor Co., Ltd.

West Ham.—Town Council. Accepted:—
Ten tramcar bodies.—Brush Electrical Engineering Co., Ltd.
Ten trucks.—Hurst, Nelson & Co., Ltd.

Wimbledon.—Electricity Committee. Accepted:—
Three 2,000-kVA transformers (£1,905).—Metropolitan-Vickers Electrical Co., Ltd.; six 100-kVA ditto (£474), Foster Engineering Co., Ltd.; thirteen 200-kVA ditto (£1,540), one 200-kVA ditto (£132); six 100-kVA ditto (£474), and three 250-kVA ditto (£420).—Hackbridge Electric Construction Co., Ltd.
Circulating water pipes for turbo-alternator (£2,727).—Brightside Foundry & Engineering Co., Ltd.
Circulating water pump (£437).—Mather & Platt, Ltd.

Forthcoming Events.

Institution of Engineering Inspection.—Friday, April 13th. Royal Society of Arts, John Street, Adelphi, W.C. 7.30 p.m. "Low-temperature Carbonisation." Mr. R. P. Wilson.

Junior Institution of Engineers.—Friday, April 13th. 39, Victoria Street, S.W. 7.30 p.m. "Calculating Apparatus and Diagrams for Engineers." Mr. A. P. Morris.

Tramways and Light Railways Association.—Friday, April 13th. Caxton Hall, S.W. 2.30 p.m. Annual meeting.

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, April 14th. Treforest. "Tungar Rectifiers and their Mining Applications." Mr. A. P. Hill.

(London Branch).—Tuesday, April 17th. Junior Institution of Engineers. 6.30 p.m. "Bulk Handling of Coal and Ore." Mr. H. H. Broughton.

Salford Technical and Engineering Association.—Saturday, April 14th. Royal Technical College. 7 p.m. "The Progress of the Diesel Engine." Mr. G. E. Windeler.

Institution of Electrical Engineers.—Informal Meeting.—Monday, April 16th. Institution, London, W.C. 7 p.m. "Wireless Reception." Mr. E. H. Shaughnessy.
Thursday, April 19th. 6 p.m. Nineteenth Kelvin Lecture, "The Revolution in Physics." Sir Oliver Lodge, F.R.S.

(London Students' Section).—Friday, April 13th. Institution, London, W.C. 6 p.m. Address by the President, Mr. Archibald Page.

(Mersey and North Wales (Liverpool) Centre).—Monday, April 16th. University, Liverpool. 7 p.m. Annual general meeting. Short papers.

(Sheffield Sub-Centre).—Wednesday, April 18th. Royal Victoria Hotel, Sheffield. 7.30 p.m. "Squirrel-cage Induction Motors." Mr. D. B. Hoseason.

Electrical Association for Women.—Tuesday, April 17th. Institution of Electrical Engineers. Annual general meeting. 9 p.m. to 2 a.m. Hotel Cecil. Ball.
Wednesday, April 18th. Lecture by Capt. Eckersley.

Overhead Lines Association.—Wednesday, April 18th. Institution of Electrical Engineers, London, W.C. 5.30 p.m. "How Far Wayleave Notice and/or Agreement Form can be Standardised for Great Britain with Advantage to all Parties Concerned." Mr. W. C. Bexon.

Society of Technical Engineers.—Wednesday, April 18th. Engineers' Club, W. 7.30 p.m. "The Applications of Aerial Ropeways in Industry." Mr. H. F. Shields.

British Institute of Radiology (Incorporated with the Röntgen Society).—Thursday, April 19th. 32, Welbeck Street, W. 8.30 p.m. "The Coolidge Cathode-Ray Tube and its Applications." Mr. C. Wainwright; and "Lantern Slide Projection of Stereoscopic Radiograms." Mr. W. E. Schall.

Notes.

Northampton Polytechnic Institute Engineering Day College.

An entrance examination in connection with the Engineering Day College will be held on Tuesday, April 24th. Further information may be had on application to the principal. (See our advertisement pages to-day.)

Appointments Vacant.

General manager of the Glasgow Corporation Electricity Department (£1,500). Three assistant district engineers (£525) for the Singapore Municipal Electricity Department. (See our advertisement pages to-day.)

The Engineers' Club (London).

An extraordinary general meeting of members of the Engineers' Club (London), Ltd., will be held on Tuesday next, at 2.30 p.m., to modify the Articles of Association and to elect additional directors.

Association of Supervising Electrical Engineers.

The examining board for the sixth annual competition for the W. E. Highfield Shield will comprise Mr. A. M. Sillar, president, Mr. W. E. Highfield, vice-president, Mr. F. W. Smith, board of control, and Mr. W. Lang. Five valuable prizes are being offered, three for members and two for associates. The member winning the first prize will also be the holder of the Shield for one year. The prizes are as follows: Members—First prize, value £5 (presented by the British Thomson-Houston Co., Ltd.); second prize, value £4 4s. (Messrs. Callender's Cable & Construction Co., Ltd.); third prize, value £2 2s. (Messrs. Siemens Bros. & Co., Ltd.). Associates—First prize, value £4 4s. (General Electric Co., Ltd.); second prize, value £2 2s. (Editor of *Electricity*). The closing date of the competition has been altered from April 23rd to April 30th, and all papers should reach head office not later than 12 noon on that date.

Electric Vehicles in Great Britain.

In a "Census of Mechanically Propelled Road Vehicles, 1927," issued by the Ministry of Transport (H.M. Stationery Office, price 6d. net), some interesting statistics concerning the extent of the use of electric vehicles in this country are given. The total number of mechanically-propelled vehicles in Great Britain for which licences were current at any time during the quarter ended September 30th was 1,899,876, against 1,729,505 for the corresponding period of the previous year. Of this total the electric vehicles numbered 1,363, against 603 for 1926. In the area under the jurisdiction of the London County Council there were 393 electric vehicles. This heads the list by a long way for any county or borough council, the next being Sheffield with 93 vehicles. Birkenhead shows 89 and Glasgow 51. Electrically-propelled cars taxed on horse power numbered 540 in 1926, but the figure dropped to 48 the next year. The most popular of the electric goods vehicles is evidently the four-tonner, of which 451 were in service. The three-tonner, the next best, accounted for 252.

The large changes in the total and in the number of cars taxed on horse-power appear to be due to changes in classification.

Electro-Farming in Canada.

Representatives of power, agricultural and manufacturing interests assembled in Winnipeg have adopted the principle of establishing a number of electrical test farms in the Province of Manitoba as a step toward the promotion of the electrification of rural areas. At a recent meeting held at the Legislative Building at Winnipeg, a General Committee was appointed which will meet shortly for the purpose of formulating plans and selecting farms capable of being utilised for electrical demonstration purposes.

Magnets for Strip-Coil Lifting.

According to the *Electrical World*, the Superior Steel Corporation at Carnegie, Pa., has installed lifting magnets produced by the Electric Controller & Manufacturing Co. for handling strip-steel coils. 200,000 lb. of strip-steel was recently loaded in this way by four men in ten hours. Ordinarily it is the work of six men in the same time to load 140,000 lb. The magnets usually handle two coils at a time, and it is found that if a thin sheet of steel is placed over the two coils to be lifted, which are placed side by side, the flux is spread sufficiently to hold both coils flat against the plate, and the plate apparently does not short-circuit the flux.

An Automatic Sub-Station in the Andes.

The accompanying illustrations are interesting, as they refer to a recently electrified mountain section of an oversea railway subject to very severe climatic conditions, frequent snowstorms, avalanches, high winds, and extreme cold. The railway in question is the Chilian Transandine Railway, the electrified section of which is supplied with power for the rack locomotives from an automatic sub-station at Juncal, Chile, high up in the Andes, near the border between Chile and Argentina. The contract for this sub-station was placed with the British Thomson-Houston Co., Ltd., Rugby, which has manufactured 23 sets of equipment similar in general design for the South African Railways.

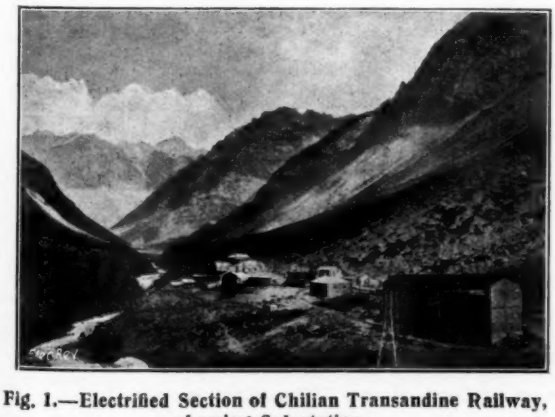


Fig. 1.—Electrified Section of Chilian Transandine Railway, showing Sub-station.

The Juncal sub-station is supplied with three-phase current at 42,000 volts by the Cia. Chilena de Electricidad, which is being fed through oil-immersed circuit-breakers to transformers which reduce the pressure to 2,300 volts for two motor-generator sets producing 3,000-V direct current for the locomotives. Each motor-generator set consists of a 1,740-kVA synchronous motor driving at each end a 750-kW, 1,500-V generator, there being an exciter for the motor at one end of the set and an exciter for the generators at the other end. The excitation of the synchronous motor is automatically controlled by a B.T.-H. patented torque motor, which enables practically unity power factor to be maintained over the whole range of operation, and ensures both good a.c. voltage regulation and maximum overload capacity for the set. For starting up the motor-generator sets, a lower voltage is obtained by means of tappings on the transformers. On the d.c. side the machines are protected by means of B.T.-H. high-speed circuit breakers.

The machines are automatically started, synchronised, and connected to the line by a single control switch, the closing of which initiates the necessary sequence of operations by setting in motion a master controller, which differs from even the most skilled human operator, in that it cannot possibly

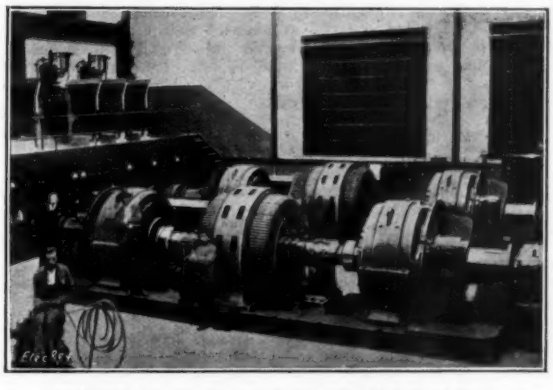


Fig. 2.—Interior of Juncal Automatic Sub-station.

make a mistake. Once a machine is running, it is protected by relays against the possible effects of faults which may develop on any part of the system. Protection against surges due to lightning is ensured by means of oxide-film arresters.

Faraday House Scholarships.

As a result of the Entrance Scholarship Examination recently held at Faraday House Electrical Engineering College, the "Faraday" scholarship was awarded to Mr. Ian C. Campbell and the "Maxwell" scholarship to Mr. W. E. Walls. Exhibitions were awarded to Messrs. E. H. Wolff, N. H. Codling, H. M. Gale, G. C. Maynard, and N. H. Bentley.

Electricity on American Farms.

An increase of 86.6 per cent. in the number of electrified farms in the United States during the three-year period ending January 1st, 1927, speaks well for the campaign which is being carried on by the Committee on the Relation of Electricity to Agriculture, composed of representatives of the U.S. Farm Bureau Federation, the Electrical Manufacturers' Association, the National Electric Light Association, and other bodies. In 1923 there were 165,000 electrified farms in the United States, while at the beginning of last year the number had increased to 227,500.

Manchester Steam Users' Association.

The annual report of the Committee of Management of the Manchester Steam Users' Association for the year 1927 shows a total revenue for the year of £40,496, resulting in a gross surplus of £1,549. The number of members of the Association at December 31st was 1,654, and the number of works and number of boilers under the care of the Association were 4,748 and 11,418 respectively. The total number of examinations made of boilers during the year was 26,768. During the year Reports were received of 71 preliminary inquiries held by the Board of Trade under the Boiler Explosions Acts of 1882 and 1890. Of these, two were followed by formal investigations, at one of which costs amounting to £100 were ordered to be paid by the parties found to be in default.

Education and Industrial Administration.

The development of educational courses dealing with subjects relating to industrial administration forms the subject of a report recently compiled by the F.B.I. Education Committee at the request of school authorities. It is agreed that modern conditions of industry necessitate a wider view of educational training for industrial positions beyond essentially technical and scientific training. The science of administration is defined as: Discovering the best method of carrying out any function concerned with industry; and ensuring that the method is put into practice. Some of the main headings which it is proposed should be considered for inclusion in courses on this subject are: legal, financial, labour, technical, publicity, selling, transport and statistics.

Fatalities.

Mr. G. H. Franklin, employed at the Leicester Corporation power station, received a fatal electric shock on April 2nd. He apparently came into contact with a "live" connection in a high-pressure cubicle.

An inquest was held on Samuel Edgar Laventine at Cardiff on March 27th, who was found lying on two pieces of cable in a shed at Cardiff Docks. The jury returned a verdict that he received a fatal electric shock while about to commit a felony.

The Batti-Wallahs' Society.

At the annual general meeting of this Society on March 28th, the following officers were elected for the ensuing year:—President: Mr. R. W. Hughman; vice-president: Mr. H. L. Howard, M.I.E.E.; committee: Messrs. A. E. Apps, H. S. Jacob, W. Lang, H. Tomlinson Lee, H. S. May, and A. E. Mohring, with Mr. M. Whitgift as hon. secretary and treasurer.

The annual dinner and dance of the Society at the Hotel Cecil on March 30th was in every way the completest success; the jolly company, presided over by Mr. G. W. Partridge, included a large number of gentlemen prominent in the electrical industry, and their ladies. Short speeches at the dinner were made by Mr. W. A. Pearman (general manager of the London Power Co., Ltd.), Mr. G. W. Partridge, and Mr. M. Whitgift.

Ultra-Violet Radiation.

In a paper, "Ultra-Violet Radiation in Industry," by Mr. Alfred A. King, read before the Society of Chemical Industry, Chemical Engineering Group, some interesting particulars were given concerning the production and use of ultra-violet radiation. Difficulties in engineering practice limit the available radiation to wave-lengths between 2,000 and 4,000 A. The upper limit is the border line of visible light, and in all work where the energy of the U.V. radiation is wanted visible light is included. The present sources of ultra-violet radiation cannot be used to transmit, even though arcs emit, radiations of shorter wave-length, as most substances, including quartz, air and water, absorb such radiation. The extinction coefficient and absorption spectra vary widely. For tetrachloride the absorption of ultra-violet is complete at a wave-length less than 2,650 A, but practically the whole of the radiation of a wave-length greater than 2,700 A. passes. The total amount of energy which can be employed as ultra-violet radiation is extremely small, and it is unlikely that U.V. will be useful for any reaction involving its use in large quantities as a source of energy. Of the total electrical energy put into the best type of mercury-vapour lamp, only 20 per cent. is recovered as ultra-violet radiation. Output of U.V. radiation depends largely upon the amperage passing through the arc, but there is with every lamp a critical voltage drop which must be maintained between the electrodes. For industrial work it is not often economical to use less than 400 to 500 volts. Very satisfactory results have been obtained by the author on a 1,000-V burner. His experience suggests that mercury-vapour lamps working at atmospheric pressure are more stable than vacuum lamps. Even clean quartz does not transmit 100 per cent. of U.V. radiation, and the lower limit of wave-length would be stopped by the merest film of charred dust, grease, and so on. Quartz jackets and covers should therefore be avoided where it is possible to use the direct radiation from the lamp. When the invisible U.V. radiation comes into contact with certain substances it is degraded in wave-lengths according to the nature of the substance, and visible light is produced. By means of the quality of this light and its colour, many substances may be identified.

Phototelegraphy.

The recent claim of some of the London newspapers that they have extended their news facilities by the adoption of means for telegraphing illustrations, &c., to and from the metropolis and some provincial centres, is indicative of the progress of phototelegraphy, which may be achieved by wire and wireless means. Services are available to the public in America, between England and America, and on the Continent of Europe, the several systems in use being known as the Ranger-Marconi, Western Electric, Thorne-Baker, Belin, Bartlane, and Siemens-Karolus-Telefunken (Siemens-Schuckert (Great Britain), Ltd.). The two last-named are understood to be those used by the London Press.

The most recent development of the system was demonstrated in the U.S.A. when the American Telephone & Telegraph Co. "telephoned" a short kinematograph film from Chicago to New York, where it was developed and made completely ready for use in exactly one hour 35 minutes after the actress had posed for it in Chicago. The total length of the film was 10 ft.; it was cut into strips 6 in. long, three of which were transmitted at a time. The cost of transmission was $10 (£2) per foot.

Institution Notes.

Institution of Electrical Engineers.

Summer Meeting.—Following upon the decision to abandon the arrangements for the proposed summer meeting in Norway, the Council has received and accepted a cordial invitation from the Committee of the Scottish Centre (Mr. D. M. Macleod, chairman) to hold the summer meeting in Scotland. The tentative programme is as follows: On Monday, June 25th, the party will assemble in Glasgow, where headquarters will be at the Central Station Hotel. On Tuesday morning there will be a reception at the University of Glasgow, followed by a visit to the new falls of Clyde hydro-electric station (by road). Luncheon will be partaken of at Lanark and tea at the works by invitation of the Clyde Valley Electric Power Co. In the evening there will be a conversazione and dance at the Central Station Hotel. On Wednesday morning the party will proceed by special train to Edinburgh, where the day will be spent in visiting the Portobello generating station, the works of Messrs. Bruce Peebles & Co., Ltd., and places of national and historical interest.

On Thursday morning the party will leave Glasgow by special train for Fort William, visit Lochaber, and see the work in progress on the power scheme, dining and sleeping at Fort William. Next morning the visitors will inspect the British Aluminium Co.'s new works, &c., after which they will leave by special steamer for an extended cruise, ending at Oban, where they will dine and sleep. The meeting ends on Saturday, June 30th, the party dispersing after breakfast.

Faraday Medal.—The Faraday Medal (Seventh Award) will be presented to Professor J. A. Fleming, M.A., D.Sc., F.R.S. (honorary member), at the meeting to be held on Thursday, April 19th, at 6 p.m. The presentation will precede the nineteenth Kelvin Lecture by Sir Oliver Lodge, D.Sc., F.R.S., on "The Revolution in Physics."

North-Eastern Centre.—By the courtesy of Messrs. Swan, Hunter & Wigham Richardson, Ltd., and of the Admiralty, arrangements have been made for a party of members of the Institution to inspect the Singapore floating dock at Newcastle-on-Tyne on Friday, April 27th; those wishing to join the party should communicate without delay with Mr. H. B. Poynder, hon. secretary of the North-Eastern Centre, Carliol House, Newcastle-on-Tyne. The party will probably assemble at 4.45 p.m. at the Wallsend yard (Station Road entrance). Light refreshments will be served from 7 to 7.30 p.m., after which Mr. E. T. Williams, Assistant Director of Electrical Engineering at the Admiralty, will deliver a lecture on "The Electrical Equipment of the Singapore Floating Dock," which will be followed by a discussion, the proceedings concluding about 9.30 p.m.

Scottish Centre.—The following gentlemen have been elected office-bearers for the 1928-29 season:—*Chairman*: Mr. D. S. Munro; *vice-chairmen*: Messrs. G. Morgan and E. Seddon; *ex-officio members* (past chairmen): Prof. Magnus Maclean, W. L. Winning, and D. M. Macleod; *hon. secretary and treasurer*: Mr. Joseph Taylor; and assistant Edinburgh hon. secretary: Mr. H. V. Henniker, with members of Committee.

Institute of Fuel.

The first annual report of the Institute of Fuel shows that at March 14th, 1928, there were on the register a total of 609 members. The income for the year was £1,241, which resulted in a credit balance of £168.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. H. Talbot, the Nottingham electrical engineer, was the principal guest at a recent dinner at the Nottingham Mechanics' Institute. The Mayor presided, and the company included the City Sheriff, Mr. T. P. Wilmshurst (Electricity Commission), Ald. Stenson (chairman, Loughborough Electricity Committee), Mr. R. H. Swain, and the Town Clerk of Nottingham. The Mayor (Ald. Huntsman) is chairman of the Nottingham Electricity Committee and the East Midlands Electricity Board. To mark his 36 years as electrical engineer Mr. Talbot was presented with a silver tea service, a canteen of silver, and a framed photograph of past and present chairmen of the Electricity Committee. Mrs. Talbot received a basket of fruit from the staff. In proposing Mr. Talbot's health, Mr. A. Clifford showed how, under Mr. Talbot's guidance, the city's undertaking had risen from very small proportions to a position of national importance.

Mr. E. J. Jarvis, late electrical engineer to the Ilkley Urban District Council, on leaving to take up the post of borough electrical engineer at Scarborough, was presented with an oak bureau by officials of the Ilkley District Council, and with a walking stick by the staff of the Ilkley Electricity Department.

The wedding took place at Cape Town on Saturday last of Mr. Frank Prangnell, son of Mr. and Mrs. N. W. Prangnell, and Miss Molly Cummings, daughter of Mr. and Mrs. Andrew Cummings, of Leith. Mr. Frank Prangnell is Messrs. A. Reyrolle & Co.'s technical representative in South Africa.

Mr. THOMAS BRITTEN, M.I.M.E., M.I.E.E., has joined the board of the Buell Combustion Co.

Mr. JULIAN C. SMITH, vice-president and general manager of the Shawinigan Water & Power Co., was recently elected president of the Engineering Institute of Canada.

Sir CHARLES PARSONS returned to England last week after a visit to South America.

Prof. Dr. C. RAMSAUER, director of the Physical Institute of the Technical High School of Dantzig, has been appointed head of the new research laboratory which the A.E.G. is establishing in Berlin.

Mr. A. C. HAILEY, manager of the North Midlands District telephone area, who has retired, has been presented by the staff with articles of antique furniture. Mr. Hadley entered the service of the National Telephone Co. at Bradford in 1884, and is succeeded by Mr. D. J. BARNES, district manager at York.

Obituary.—MR. GEORGE OFFOR.—With great regret we learn that our old friend Mr. George Offor passed away peacefully at Sydenham on Easter Day, one week after celebrating his 101st birthday. In our Jubilee Issue of November 17th, 1922, we gave an account of Mr. Offor's career, and in our issue of March 25th last year, on the occasion of his reaching the age of 100 years, we reproduced his portrait, together with a brief account of his connection with the electrical industry. Mr. Offor was early in the field, being closely associated with the Brush Company, and started an electrical manufacturing and contracting business in London, carrying out some notable electric lighting installations. Later he was engaged in the promotion of electricity supply undertakings in the north of England. He was a member of the Committee which was appointed, with Lord Thurlow as chairman, to consider the amendment of the Electric Lighting Act of 1882.

Will.—The late Mr. L. GREENING, chairman of N. Greening and Sons, Ltd., wire-drawers, &c., Warrington, left £14,361 gross (£14,155 net personalty).

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Brock Refrigerator Co., Ltd.—Private company. Registered March 28th. Capital, £10,000 in 7,500 10 per cent. cumulative preference shares of £1 each and 50,000 ordinary shares of 1s. each. Objects:—To carry on the business of refrigerator and refrigerating plant manufacturers, mechanical engineers, workers, suppliers, and dealers in refrigerators, electricity, motive power, heat and light, &c. The subscribers (each with one preference share) are:—A. W. Pears, 6, Colchester Avenue, Manor Park, E.12, clerk; L. Alexander, 13, Salisbury Road, Upper Holloway, N.19, clerk. Registered office: 19, Basinghall Street, E.C.2.

British Automatic Refrigerator Co., Ltd.—Private company. Registered March 27th. Capital, £1,000 in 750 "A" and 250 "B" shares of £1 each. Objects:—To carry on the business of refrigerating, insulating and general engineers and contractors, electrical engineers and contractors, &c. The subscribers (each with one "A" share) are:—H. Shephard, 25, Dover Street, W., solicitor; W. Annear, 57, James Street, Cardiff, solicitor. Secretary (*pro tem.*): S. W. Brockwell.

P. Kay, Ltd.—Private company. Registered March 30th. Capital, £3,000 in £1 shares. Objects:—To carry on the business of wireless merchants and electrical, wireless, and mechanical engineers and manufacturers, workers in wireless and electrical motive power, &c. The first directors are:—P. Kay, 34, Craven Walk, Stamford Hill, general merchant (managing director and chairman); Mrs. C. Kay, 34, Craven Walk, Stamford Hill (both permanent). Secretary: P. Kay. Registered office: 159, Bishopsgate, E.C.2.

Neolight Signs Co., Ltd.—Private company. Registered March 30th. Capital, £1,000 in £5 shares. Objects:—To carry on the business of manufacturers, sellers, buyers, renters and importers and exporters of all kinds of luminous signs of the neon or other types, signalling and electrical apparatus, &c. The subscribers (each with one share) are:—J. Demoulin, 98, Great Russell Street, W.C.1, electrical engineer; W. Clegg, 73, Temperley Road, Balham, S.W.12, sales manager. The first directors are: R. Francotte (chairman), 64, Rue du Prince Royal, Brussels, and J. Demoulin.

A. Vandam & Co., Ltd.—Private company. Registered April 2nd. Capital, £1,500 in £1 shares. Objects:—To carry on the business of electrical, mechanical, wireless and general engineers and contractors, &c. The first directors are:—A. Vandam, Onslow Court Hotel, Queen's Gate, South Kensington, S.W.; E. H. Charsley, Bridge House, High Street, Bexley; H. M. D. Still, Onslow Court Hotel, Queen's Gate, South Kensington, S.W. (all permanent, subject to each holding 500 ordinary shares). Qualification of ordinary directors, 100 shares. Secretary: E. H. Charsley. Registered office: Room 408, Caxton House, Westminster, S.W.1.

Helios Electrical Co., Ltd.—Private company. Registered April 3rd. Capital, £200 in £1 shares. To adopt an agreement with A. M. Everett and to carry on the business of wholesale electrical and general engineers and merchants carried on by him as "The Helios Electrical Company" at 89, Melbourne Street, and Prudential Buildings, Above Bar, Southampton. The subscribers (each with one share) are:—L. H. Butcher, 52, Gaskarth Road, Balham Hill, S.W.12, solicitor's managing clerk; Edna M. Green, 86, Ranelagh Road, Tottenham, N.15, secretary. The first directors are J. M. Bein (permanent) and others to be appointed by the subscribers. Registered office: 110, High Street, Southampton.

Bernard L. Oldfield, Ltd.—Private company. Registered April 4th. Capital, £100 in £1 shares. Objects:—To carry on the business of dealers in all manufactures in connection with the metal, electrical, wireless, engineering or automobile trades, &c. The subscribers (each with one share) are:—B. L. Oldfield, 18, Baden Road, Hall Green, Birmingham, manufacturers' representative; H. S. Arscott, 52, Albert Road, Handsworth, Birmingham, clerk. B. L. Oldfield is the first director. Registered office: 42, Great Charles Street, Birmingham.

Sun Ray and Health Institutes (West London), Ltd.—Private company. Registered April 2nd. Capital, £2,000 in £1 shares. Objects:—To carry on the business of proprietors of massage, electrical, sun-ray treatment and X-ray establishments, &c. The subscribers (each with one share) are:—J. Auerbach, 22, St. John's Road, N.1, articled clerk; C. T. Callagher, 38, Thirsk Road, Clapham Common, S.W.11, accountant's clerk. Secretary: F. Lacey. Registered office: 52, Queen Victoria Street, E.C.4.

Wessex Agencies, Ltd.—Private company. Registered April 3rd. Capital, £200 in £1 shares. Objects:—To carry on the business of factors of, agents for, and wholesale and retail dealers in electrical fittings, apparatus, appliances and accessories, including radio apparatus, heating and cooking apparatus, &c. The subscribers (each with one share) are:—L. H. Butcher, 52, Gaskarth Road, Balham Hill, S.W.12, solicitor's managing clerk; Edna M. Green, 86, Ranelagh Road, Tottenham, N.15, secretary. The first directors are J. M. Bein (permanent) and others to be appointed by the subscribers. Registered office: Prudential Buildings, Above Bar, Southampton.

London Wholesale Electrical Supplies Co., Ltd.—Private company. Registered March 31st. Capital, £100 in £1 shares. Objects: To carry on the business of electrical engineers, manufacturers of accessories, and buyers, sellers and agents for export and import of all commodities connected with the business of electrical and radio engineers, &c. The first directors are:—P. Thomas, merchant; and E. Thomas, both of 2b, Hyde Park Mansions, N.W. Secretary: G. Simpson. Registered office: Rutland House, Beer Lane, Lower Thomas Street, E.C.3.

Official Returns of Electrical Companies.

G. Haslam & Co., Ltd.—Capital, £2,000 in £1 shares. Return dated November 26th, 1927 (filed March 14th, 1928). 1,712 shares taken up. £512 paid. £1,200 considered as paid. Mortgages and charges, nil.

Gilwern Manufacturing Co., Ltd.—Issue on March 15th, 1928, of £300 debentures, part of a series already registered.

H. T. C. Electrical Co., Ltd.—Capital, £2,500 in £1 shares. Return dated January 2nd, 1928. All shares taken up. £950 paid. £1,550 considered as paid. Mortgages and charges, nil.

Normand Electrical Co., Ltd.—Capital, £7,000 in £1 shares. Return dated December 31st, 1927 (filed March 8th, 1928). 6,015 shares taken up. £6,015 paid. Mortgages and charges, £1,200.

International Hydro-Electric Development Syndicate, Ltd.—Capital, £10,000 in £1 shares. Return dated January 13th, 1928. 2,254 shares taken up. £2,254 paid. Mortgages and charges, nil.

Nefa Co., Ltd.—Capital, £1,000 in £1 shares. Return dated January 14th, 1928. 999 shares taken up. £999 paid. Mortgages and charges, £500.

Stella Conduit Co., Ltd.—Capital, £20,000 in £1 shares. Return dated December 31st, 1927. All shares taken up. £20,000 considered as paid. Mortgages and charges, nil.

London Electric Warehouse Co., Ltd.—Capital, £1,000 in £10 shares. Return dated December 31st, 1927. Eight shares taken up. £10 per share called up. £10 paid. £70 in arrears. Mortgages and charges, nil.

Luminograph Co., Ltd.—Capital, £1,000 in £1 shares. Return dated January 13th, 1928. All shares taken up. £1,000 considered as paid. Mortgages and charges, £1,500.

Hungerford and District Electricity Supply Co., Ltd.—Debenture dated March 21st, 1928, to secure £50, charged on the company's undertaking and property, present and future, including uncalled capital. Holder:—Mrs. A. G. Mason, 82, Albert Hall Mansions, S.W.7.

H. R. Martindale, Ltd.—Particulars filed of £1,500 debentures authorised March 20th, 1928, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Palmer, Riley & Co., Ltd.—Satisfaction in full on March 10th, 1928, of mortgage and further charge dated January 29th and March 27th, 1923, securing jointly £1,200.

Hammersley Bros., Ltd.—R. W. Beken, of 213, Hoe Street, Walthamstow, ceased to act as receiver or manager on December 1st, 1927. (Notice filed March 29th, 1928.)

Correcta Light, Ltd.—Capital, £25,000 in 22,000 10 per cent. cumulative participating preference shares of £1 each and 30,000 ordinary shares of 2s. each. Returns of allotments made up to March 28th, 1928, show 557 preference shares allotted, payable in cash and fully called up, and 4,500 preference and 25,635 ordinary shares allotted as fully paid. Mortgages and charges nil.

Mackallen Heating Co., Ltd.—Capital, £99 in £1 shares. Return dated January 6th, 1928. All shares taken up. £99 paid. Mortgages and charges nil.

British Resistor Co., Ltd.—Capital, £1,000 in £1 shares. Return dated March 26th, 1928. All shares taken up. £1,000 paid. Mortgages and charges nil.

Electric Light Insurance and Maintenance Co., Ltd.—Capital, £5,000 in £1 shares. Return dated February 1st, 1928. 1,255 shares taken up. £1,257 10s. paid (including £2 10s. paid on 50 forfeited shares). Mortgages and charges, £2,074.

Robert W. Blackwell & Co., Ltd.—Capital, £50,000 in £1 shares. Return dated January 14th, 1928. All shares taken up. £18,338 paid. £31,662 considered as paid. Mortgages and charges, £14,000.

Electro-Mechanical Supplies, Ltd.—Capital, £3,000 in £1 shares. Return dated January 14th, 1928. 999 shares taken up. £999 paid. Mortgages and charges nil.

Brandes, Ltd.—Capital, £20,000 in £1 shares. Return dated January 3rd, 1928. All shares taken up. £10,392 paid. £9,608 considered as paid. Mortgages and charges nil.

City Notes.

Clyde Valley Electrical Power Co.

This company's report for 1927 was reviewed in our issue of March 30th (p. 563). The annual meeting was held on April 4th, when Sir Frederick C. Gardiner, K.B.E. (chairman), who presided, said that although the area which they served had suffered from serious trade depression the gross profit had increased substantially. The accounts showed a saving of £147,000 in the cost of fuel; that was due mainly to the purchase of energy from their subsidiary, the Lanarkshire Hydro-Electric Power Co., whose stations at the Falls of Clyde commenced operations during the year. There were also increases in the quantities of energy purchased from the Greenock Corporation and the Ayrshire Electricity Board. Sir Frederick drew special attention to the increase of about £9,000 in rates and taxes, and said that in ten years the company's valuation had risen from £53,800 to £184,000, local rates from £12,000 to £75,000, and the average rate per £ from 4s. 6d. to 8s. 2d. Producers were heavily burdened by rates and taxes, which increased costs, restricted trade, and added to unemployment. Public utility undertakings bore a much higher charge for rates than other industries. The adverse conditions in the area prevented the connection of any new large power consumers, but that was very largely compensated for by the growth in the demand for domestic and general purposes. They had given special attention to that class of supply, and during the year had extended their service to a number of additional districts. The sales of energy during the year increased by 33 per cent. to 220 million kWh, and the total connections rose by 15,542 h.p. to 250,029 h.p. During the first quarter of the current year the sale of energy had risen by 13 per cent. as compared with the corresponding period of last year. The average price received for energy during 1927 was 0.783d. per kWh, and the combined average price received by the company and its subsidiaries was 0.857d. per kWh. The Central Scotland scheme had been considered by the directors, and representations were made which secured modifications to safeguard the interests of the company.

Anglo-Portuguese Telephone Co., Ltd.

The annual meeting was held on April 3rd, Sir Alexander Roger (chairman) presiding. In moving the adoption of the report and accounts (ELEC. REV., March 30th, p. 564), the chairman said that the past year had been a very active one; they had increased their capacity for service and were soon to make an intensive effort to increase the number of subscribers. They had provided for a more ambitious scale of development during 1928; they were endeavouring to meet the telephone needs of Lisbon and Oporto by installing equipment which would be revenue-producing at the earliest possible moment. In Oporto, during the past year, they had changed over from the old Central Exchange to modern equipment in their new and more commodious premises. The chairman then made reference to the new 40-year concession which had been obtained. That, he said, would afford them a security of tenure which would enable them to adopt and maintain a steady progressive programme of development. The contract provided for the institution of a message-rate system, but that was being deferred pending a study of an alternative basis. Sir Alexander then mentioned recent fluctuations in the value of the escudo, which he attributed mainly to the temporary suspension of negotiations for the foreign loan which the Portuguese Government desired to make. He said that there was reason to hope that before long negotiations would be re-opened and the loan successfully floated. The company's new contract provided for the adjustment of the tariffs in the event of any appreciable fluctuation of the exchange. The chairman stressed the fact that it was the company's intention to develop the new concession to the utmost.

British Automobile Traction Co., Ltd.

The surplus for the past year was £75,623, and with the addition of £10,416 brought forward, a sum of £83,039 is available. The participating preference shares are to receive an additional 2 per cent., making 10 per cent. for the year, and the ordinary dividend is 10 per cent. Arrangements have been made to acquire from Messrs. Thomas Tilling & Co., Ltd., the British Electric Traction Co., Ltd., and others, shares in provincial omnibus companies, in the majority of which the company is already interested, to a total of £920,325. In exchange for these, 868,296 of the company's ordinary shares will be allotted. It is proposed to raise the ordinary capital by £1,400,000, making the total authorised capital £2,000,000. Of this, £331,704 will be offered to shareholders and £200,000 will remain for future issue. It is proposed to change the company's name to "Tilling and British Automobile Traction, Ltd."

Llanelly and District Electric Supply Co., Ltd.

Mr. A. H. Beatty, O.B.E. (chairman), presided at the annual meeting on April 3rd. In the course of his speech, he said that although the industries of the district were in a state of almost unparalleled depression, the company's business had continued to expand. The sales of energy had increased by nearly 50 per cent. The load had grown to such an extent that it had been necessary to order a new 7,500-kW set and auxiliaries to be installed in time to meet next winter's load. The new plant would reduce operating costs, and there should be an improvement in profits which would enable the directors to consider the resumption of the ordinary dividend. To provide for the new plant and for future extensions, further capital would be necessary, and proposals for increasing both the preference and the ordinary capital would be put forward in the course of the next few weeks, with a view to an issue at a favourable opportunity.

Notting Hill Electric Lighting Co., Ltd.

The report for the year ended December 31st last, shows that the available profit (including £7,594 brought forward) is £85,756. After meeting all charges and the preference dividend, it is proposed to pay a final dividend of 8s. 7.636d. per share on the deferred shares, making 13s. 7.636d. per share for the year. The average standard price has been agreed with the L.C.C., subject to confirmation by the Electricity Commissioners, at 4.140d. per kWh. During the year the whole of the bulk supply has been obtained from the London Power Co. Considerable progress has been made in changing over the distribution system from two-wire to three-wire. When completed, this will largely increase the carrying capacity of the mains. The number of consumers increased from 9,183 to 9,687, the connections from 15,155 to 16,329 kW, the energy sold from 6,319,770 to 6,975,960 kWh, and the gross revenue from £126,629 to £137,612. The balance of the preference shares (£56,000) have been issued to existing shareholders and employés of the company; they have all been fully paid up. Mr. C. B. B. Bingham-Smith has been appointed to the board. Meeting: April 17th.

Para Electric Railways and Lighting Co., Ltd.

The figures in the report for the year ended November 30th last are converted at an average rate of 5.85d., as compared with 7.24d. for the preceding year. The gross receipts are given as £173,032 (against £203,902), and the total net revenue as £70,527 (against £71,620). The available balance (with £7,785 brought forward) is £35,448. It is proposed to transfer £10,000 to depreciation and renewals reserve (against *nil*) and £10,000 to general reserve (as before), and after paying a dividend of 3 per cent. on the preference shares, a balance of £5,698 is to be carried forward. Messrs. G. M. Booth and P. A. Cooper have been appointed directors, and Mr. E. S. Baring-Gould has resigned from the board. Meeting: April 16th.

British Electric Transformer Co., Ltd.

The net profit for the past year was £53,703, and to it is added £9,402 brought forward, making £63,105. The preference dividend is paid, £10,000 is transferred to reserve and £5,000 to depreciation reserve, a dividend of 5 per cent. is recommended on the ordinary shares, and £10,855 is carried forward. To celebrate the completion of Mr. A. F. Berry's 30 years with the company the directors propose to set aside £1,000 to form the nucleus of a pension fund for the employés. The net profit for 1927 was £63,202, similar amounts were allocated to the reserves, and the same dividend was paid. Meeting: April 17th.

Chelsea Electricity Supply Co., Ltd.

The directors' report for the year ended December 31st last states that after providing for debenture interest, sinking funds, &c., the net profit is £64,217. The final dividend on the ordinary shares is 11s. 3d. per share, making up the standard dividend of 8¼ per cent. for the year. The balance carried forward, subject to superannuation fund contribution and shareholders' proportion of consumers' benefit, is £27,318. The connected load rose by 704 kW to 13,451 kW, and the sales of energy by 1,065,370 kWh to 8,812,248 kWh. Meeting: April 19th.

British Columbia Electric Railway Co., Ltd.

The *Financial News* reports that Lord Rothermere, in conjunction with Canadian associates, is offering to purchase the whole of the preferred ordinary and deferred ordinary stocks of the company at the price of 240 per cent. for the former and 280 per cent. for the latter. There was £1,440,000 of each class of stock in the last balance sheet, but since then new deferred ordinary stock has been offered at par to holders of both classes to the extent of about 30 per cent. of the total (£2,880,000).

Companies to be Struck Off the Register.

The names of the undermentioned companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

Associated Battery Co., Ltd.
Coventry Electric Clock Co., Ltd.

Mexican Light and Power Co.

The directors have declared the full half-yearly dividends on the 7 per cent. cumulative preference shares and the 4 per cent. cumulative redeemable second preference shares. The latter were issued last year in satisfaction of the arrears of dividend on the 7 per cent. preference shares.

Babcock & Wilcox, Ltd.

The directors recommend a final dividend of 8 per cent. on the ordinary shares, making 15 per cent., tax free, for the year, against 13 per cent. for 1926.

Electrical Finance and Securities Co., Ltd.

The directors recommend a final ordinary dividend of 1s. per share. An interim dividend of 5 per cent. has already been paid.

Simms Motor Units, Ltd.

Out of a profit of £38,566 for 1927 (against £30,565), a dividend of 15 per cent. is declared on the ordinary shares (5 per cent. already paid), against 12½ per cent. for 1926.

Mansfield and District Tramways, Ltd.

The balance at credit of revenue account for the past year is £10,568, and to it is added £15 brought forward, making £10,583. After meeting debenture and loan interest, &c., a balance of £4,717 is carried forward.

London Electric Wire Co. & Smiths, Ltd.

The profit for the past year was £75,613, as compared with £90,868 in 1926. The allocation to reserve is reduced from £25,000 to £20,000, but the ordinary dividend is maintained at 7½ per cent. A balance of £20,789 is carried forward, against £23,480 brought in.

Stocks and Shares.

TUESDAY EVENING.

THE week under review contained the Easter holidays and the fag-end of a 21-day account, but in spite of these two drawbacks business all round the House continued to be exceedingly active; in fact, dealings for the End-April account opened with a blaze of strength on Thursday last. With the exception of the Rubber Market, which was demoralised by the Prime Minister's announcement in the House of Commons that restriction would be abolished as from November 1st next, every section of the House participated in this activity. Gilt-Edged Stocks and the better class Foreign Government Bonds were exceptionally good. Industrials, it is hardly necessary to state, were aggressively active, and Electric Light shares, as usual, received their full share of attention.

Home Rails.

There was little more business in the "Heavy" Rails, the junior securities of which continued to be put away by long-term investors. Metropolitans have again been in demand on purchase rumours, and moved sharply to 71, a rise of practically four points. Underground ordinaries have been fairly active, but have not succeeded in getting beyond the 25s. mark. Rumour continues to discourse on the form which the new Underground issue is to take, and a 5 per cent. debenture stock is now talked of. The fine Easter holiday has no doubt resulted in bumper traffics for the Underground system generally, and with their announcement both the ordinaries and the income stock which is now 118 are likely to go higher.

Home Electricity Supply.

Business in Electric Light Shares continues to be extremely active. As regards price movements, Bournemouth and Poole ordinary were the star turn of the week, rising at one time to 78s. 6d. on absorption talk. A considerable number of shares changed hands, but after a while profit-taking ensued, and the price sagged to 3⅞, which is still 6s. 6d. above the previous week's level. The usual investment business was seen in the shares and debentures of the London Group. London Power 5 per cent. debenture stock was an extremely active spot at 99¼, free of stamp, large amounts of stock being placed each day. Counties were much in evidence, and continued their rise to 37s. c.d. Metropolitans were not quite so active as of late, but managed to recover the dividend, and are now 45s. x.d. Urbans were inclined to be on the dull side, and Llanellys were sold down to 13s. 3d. on the passing of the dividend for the second year in succession. Isle of Thanets remain round 37s. 6d., but the preference are higher at 31s. 6d. There has been a certain amount of buying here for "New Time" during the last few days, which may or may not be significant, as rumour is busy with talk of an impending bid for control. Turning to bulk supply concerns, Lancashires were a strong market at 30s. on dividend prospects, and, in some quarters, are talked higher. A large business was seen in the new Midland Counties ordinary, which are now 1s. premium bid. The old have sagged away a little to 25s. 9d.—a drop of 9d. The yield here is now a full 5 per cent., which is higher than can be obtained on the majority of English bulk supply ordinary shares. Yorkshire new ordinaries at 7s. 9d. premium were a shade off on selling by shareholders who had applied for and got, a few excess shares—at the issue price, of course. It is rather extraordinary that there should be such a thing as excess shares with a share nil paid and 9s. premium bid—as Yorkshires were only a few days ago. Newcastles continued in inquiry, and are 27s. 6d., with the new 26s. 6d., both *cum* dividend. Newcastle and Districts are better at 27s. 6d. *cum* the year's dividend of 7½ per cent. The maintaining of the Shropshire, Worcestershire and Staffordshire "B" ordinary dividend at 7 per cent. for last year caused a little disappointment, as 8 per cent. was being looked for, but in spite of this the price is practically unaltered at 31s. It is understood that a further issue of 6 per cent. preference shares is on the tapis. North Wales Power ordinary were not able to hold their previous week's rather rapid rise, and boiled over a little to 17s. 3d.

Overseas Electrical Securities.

The securities of overseas electrical undertakings call for little comment. Mexican Light and Power common have again been moving in a very erratic manner, but ended the week practically unchanged at 102¼. Perak River Hydro-Electric 7 per cent. convertible debenture stock was in inquiry, and is now 107½, but the ordinaries remain quiescent at 15s. East African preference were better at 22s. 6d., with the ordinaries 28s. bid. Some of the Indian companies—Calcutta and Madras, for example—were again fairly active, but without price movements worth mentioning. Southern Brazil Electric 6½ per cent. debenture were in speculative demand, and hardened to 77¼.

Tramways.

Both London and Suburban Traction and London United Tramways continue to be increasingly active as the changed position of these two concerns, owing to the recent Motor Omnibus deal, begins to "sink in." The preference in both cases are now 9s. 3d. buyers for choice. London and Suburban ordinaries were 2s. 9d., with the 5s. ordinary shares of the London United Tramways 2s. 3d. Practically the same thing can be said of the Potteries Electric Traction ordinary shares, a large number of which have changed hands during the week up to as high as 5s. 9d., as against 2s. 6d. a few months ago. The preference are also higher at 8s. 6d., but have not risen in the same ratio, and at present prices, in view of dividend arrears and cumulative rights, appear the cheaper purchase of the two. British Electric Traction preferred and deferred were both reasonably active, the deferred marking up to 55s. Para Electric Railway ordinaries at 5s. and the preference at 14s. were both much better on the report and announcement of the payment of a year's preference dividend. Profits were practically the same as a year ago, in spite of the fall in the milreis. Last autumn the board brought out a rather drastic writing down scheme, which met with a considerable amount of opposition, and was eventually postponed until the publication of the accounts for 1927. Rather curiously no mention was made of this scheme in the report which has just been issued. British Columbia Electric deferred and preferred ordinary stock both rose sharply on the announcement in the Press this morning that stockholders were about to receive a bid of 240 for the preferred and 280 for the deferred. This bid emanates from Lord Rothermere, in conjunction with a group of Canadian associates. It is understood that Lord Rothermere is already the largest stockholder in the company. This has been a well-kept secret, and has taken the market completely by surprise, although it was rather mystified by the continued upward movements of these two stocks during the last few months. Closing prices are 240 for the preferred, 280 for the deferred, and 56s. for the recently issued £1 deferred shares. Mexican Tramways common were again active, and are now 48¼, with the 5 per cent. gold bonds unchanged at 82. Brazil Tractions were not unnaturally a little tired after their previous hectic rise, and shed a point at 235.

Telegraphs and Telephones.

Cable shares were not very exciting, and there is hardly a price alteration to report. Eastern Telegraph ordinary stock continued to meet investment demand, and has risen further to 208½. There would appear to be further scope for appreciation here if the proposed wireless-cum-cable merger becomes *un fait accompli*, as the securities in the holding company given in exchange for each £100 Eastern Telegraph ordinary stock should be worth something in the neighbourhood of 300. Globes, although slightly higher in price, were not so active as during the previous week, and United River Plate ordinary are again fractionally lower at 11. Marconis have been moving within narrow limits, and call for no particular comment. Dealings have started in the £1 shares resulting from converted debenture stock. The price is 5 15/16, equal to slightly under 60s. for the 10s. shares. These shares are worth watching, as it might pay holders of the 10s. share to sell and re-invest in the £1 (technically called "straddling") as apart from the £1 shares being rather a restricted market there is absolutely no difference between the two classes, each £1 share enjoying all the advantages of two 10s. shares. Marconi preference are around 5¼, and the debenture stock is now 187, after moving between 180-190. Marconi Marines continue a sound market, and are now 48s., a rise of 5s.

Manufacturing.

The 15 per cent. dividend of Babcock & Wilcox, although 2 per cent. better than for the previous year, did not fulfil highest expectations, and the shares sagged off to 70s., the excellent balance sheet position being ignored. English Electrics, both ordinary and preference, were dull and lower at 8s. 6d. and 12s., respectively. General Electrics at 36s. failed to retain their small rise of the previous week, and Metropolitan-Vickers and Siemens, although practically unchanged, were hardly mentioned. A dull spot was British Aluminium ordinary, which weakened to at one time 44s. 3d., as against 53s. 6d. earlier in the year, on the meeting and intimation of the board's policy to strengthen the company's reserves, rather than increase the dividend, in view of future expenditure. This policy, although to the benefit of the shareholders in the long run, did not suit the books of the quick turn operators, and resulted in a certain amount of share jettisoning.

Share List of Electrical Companies.

	Nom.	Dividend. 1926.	1927.	Price April 10. 1928.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	£ 1	14†	—	77/6	+6/6	3 11 10
Brompton Ordinary	1	8⅝	—	26/-	—	5 7 8
Charing Cross Ordinary	1	8½	8½	26/6xd	—	5 5 8
do. do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8⅝	8⅝	26/-	—	5 7 8
City of London	1	10	10	30/-xd	—	4 13 4
do. do. 6% Pref.	1	6	6	23/-xd	—	5 4 4
Clyde Valley	1	8	8	34/-	—	4 14 2
County of London	1	7½	7½	37/-	+1/6	4 1 1
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundsons' Ordinary	1	10	—	67/6	—	2 19 2
do. 7% Pref.	1	7	7	25/6	—	5 9 10
Elec. Supply Corporation	1	11	—	52/-	—	4 4 7
Kensington Ordinary	1	8	8	26/-	—	5 7 8
Lancs. Light and Power	1	7½	—	30/-	—	5 0 0
London Electric	1	8½	8½	25/6	—	5 9 10
do. do. 6% Pref.	5	6	6	5⅝	—	5 8 2
Metropolitan	1	8	9	45/-xd	—	4 0 0
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6½	26/-	—	5 0 0
Newcastle-on-Tyne Ordinary	1	5	6	27/6	—	4 7 3
do. 5% Pref.	1	5	5	18/9	—	5 6 8
do. 7% Pref.	1	7	7	26/-	—	5 7 8
Notting Hill 6% Pref.	10	6	6	10⅝	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	5	8	8	26/6	—	5 5 8
South London	1	8½	8½	26/6	+6d.	5 5 8
South Metropolitan Pref.	1	7	7	1¼	—	6 3 0
Urban Ordinary	1	7	—	47/6	—2/6	2 19 0
do. 6% Pref.	1	6	6	1⅛	+1/16	5 6 8
Westminster Ordinary	1	8½	8½	26/-	—	5 7 8
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	21/7½xd	—	6 18 9
Yorkshire Elec.	1	8	8	33/6	—	4 15 7
Home Rails.						
Central London Ord. Assented	Stock	4	4	74	—½	5 8 1
Metropolitan	,,	3	3	71	+3½	4 4 6
do. District	,,	3½	4	75½	+½	5 6 0
Underground Electric	£1	1½	5	25/-	—	4 0 0
do. do. Income	Bonds	6	6	118	—	5 1 8
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	99½	—	6 0 8
do Def.	,,	1½	1½	24½	—	6 1 10
Automatic Telephone	1	10	10	46/3xd	—	4 6 6
Chili Telephone	5	6	—	7⅞	—	*3 18 3
Eastern Extension	10	10	10	20	—	*5 0 0
Eastern Tel. Ord.	Stock	10	10	208½	+3½	*4 15 11
Globe Tel. and T. Ord.	10	10	10	21½	+½	*4 13 0
do. do. Pref.	10	6	6	10½	—	5 17 1
Great Northern Tel.	10	20	—	39½	—	5 1 2
Indo-European	25	10	—	40	—	*5 0 0
Marconi	10/-	5	—	62/6	—1/6	1 12 0
Marconi-Marine	1	8½	12½	48/-	+5/-	5 4 2
Oriental Telephone Ord.	1	12	—	52/6	—	*4 11 7
United R. Plate Tel.	5	8	8	11	—⅛	*3 12 9
Western Telegraph	10	10	10	20½xd	+½	*4 18 9
Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	5⅞	—	7 6 8
do. do. 2nd Pref.	5	6	6	8½	—	7 17 4
do. do. 5% Deb.	Stock	5	5	78½	—	6 7 5
British Electric Traction Def. Ord.	,,	—	—	530	—	... ...
do. do. 8% Pref. Ord.	,,	8	—	134½	—	6 8 6
Brazil Traction	100	6	—	235	—1	*2 11 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	94½	—	5 5 10
do. do. Preferred	,,	6½	6½	240	+6½	*2 12 1
do. do. Deferred	,,	8	8	280	+47½	*2 17 2
do. do. Deb.	,,	4½	4½	81½xd	—	5 4 4
London & Sub. Trac. 5% Pref.	1	Nil	Nil	9/-	+6d.	... ...
London United Tram Deb.	Stock	4	4	57½	—	6 19 2
Mexico Trams, 5% Bonds	—	5	5	82	—	6 5 1
Mexican Light Common	100	Nil	Nil	102½	—	... ...
do. 7% Pref.	100	Nil	7	86	+2	8 2 9
do. 1st Bonds	—	5	5	82½	—	6 6 2
Yorkshire (West Riding)	1	Nil	Nil	7/-	—6d.	... ...
Manufacturing Companies.						
Babcock & Wilcox	1	13	15%	70/-	—6d.	4 5 9
British Aluminium Ord.	1	10	10	45/9	—1/9	*4 7 0
British Elec. Transformer Pref.	1	7	7	19/-	—	7 7 4
British Insulated Ord.	1	15	15	4½xd	—	3 12 8
Brush Ord.	1	10	—	29/-	—	6 17 11
Callenders	1	15	—	4⅜	—	3 8 2
do. 6½% Pref.	1	6½	6½	23/-	—	5 9 5
Crompton Parkinson Pref. Ord.	1	—	—	17/6	—	... ...
Edison-Swan	£/-	10	10	10/-	—	4 0 0
do. 5% Deb.	Stock	5	5	90	—	5 11 0
Electric Construction	1	7½	—	27/-	—	5 11 1
Enfield Cable Pref.	1	7½	7½	26/3	—	5 14 8
English Electric	1	Nil	Nil	8/6	—6d.	... ...
do. do. Pref.	1	3	Nil	12/-	—6d.	... ...
Gen. Elec. Pref.	1	6½	6½	24/-	—	5 8 4
do. Ord.	1	7½	—	36/-	—9d.	4 3 4
Henley	1	25	—	5⅜	—	4 9 0
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	1	12½	—	53/9	—	4 13 7
Met.-Vickers Ord.	1	8	6	30/-xd	—	4 0 0
do. Pref.	2	8	8	22xd	—	6 1 11
Siemens Ord.	1	7½	—	28/3	—9d.	5 6 2
Telegraph Construction	12	10	10	26½	—	*4 10 11

* Dividends paid free of Income Tax.
† 4% of which was Tax Free.

Mexican Conditions and Developments.

Depression in Staple Industries.

A REPORT on the economic and financial conditions in Mexico, dated November, 1927, has been presented to the Department of Overseas Trade by Mr. E. C. Buxton, Commercial Secretary, Mexico City. (Stationery Office, 2s. net.)

In the introduction to the report reference is made to some factors which have had an adverse influence upon Mexican affairs. One of these is the fall in the price of silver, which, as Mexico is the leading producer, has badly affected the silver-mining and allied industries. The Petroleum Law, passed in 1925, has met with the disapproval of the principal oil companies, as it is regarded as a threat to acquired rights. In consequence, production in the oilfields has waned considerably. This, in turn, has caused a diminution in export duties, and reduced imports have lowered the import duty receipts in spite of numerous increases in the tariff. Currency depreciation has increased the cost of imported goods. The authorities are conducting a "Buy Mexican Goods" campaign, and the Tariff Commission is to study the possibility of affording home production an even greater measure of protection. Mr. Buxton says that it is difficult to suggest when any improvement in conditions is likely to occur.

A National Electrical Code.

The Government is animated by a desire to foster industrial development in Mexico, in the hope that eventually the country will become less dependent upon imported manufactures, and it aims at the possibility of placing cheap and abundant power at the disposal of the future Mexican manufacturer, as well as the agriculturist. A National Electricity Code promulgated in 1926 provides that the regulation and supervision of the generation and distribution of electricity shall come under the jurisdiction of the Federal Government exclusively. The Ministry of Industry, Commerce and Labour has issued a large volume of regulations affecting electrical installations, wiring cables, generating stations and transformers, tramway systems, &c., all of which are to be supervised by the Ministry's electrotechnical control department.

Hydro-Electric Development.

A great deal of official hydro-electric exploration work has been done, and it is estimated that it will be possible to develop six million h.p. eventually; at present the development amounts to about 350,000 h.p. The largest producer of hydro-electric power is the Mexican Light & Power Co., Ltd., which has five stations, with an aggregate capacity of 175,000 h.p. The company contemplates the expenditure of some £3,000,000 on further developments. The energy generated is transmitted to Mexico City and the Pachuca silver-mining district at 85,000 V, and a line is carried beyond the city to the gold and silver mines of El Oro and Angangueo. Eight smaller hydro-electric plants and four steam stations are owned by the company; the whole undertaking is rated at about 200,000 h.p., and in 1925 produced about 561 million kWh.

Another very modern system is that of the Orizaba Light and Power Co., which supplies energy to places as far apart as the port of Vera Cruz and Puebla. It provides the power for the electrified mountain section of the Mexican Railway Co.

Electrical Imports.

An appendix to the report shows that in 1926 "switches, &c., and bulbs for making electric lamps" to the value of 1,116,044 pesos were imported into Mexico, as compared with 1,093,408 pesos in 1925. Arc lamps and parts were valued at 11,339 pesos (against 6,544 pesos), and incandescent lamps at 1,076,107 pesos (against 1,058,688 pesos). Other import items during 1926 were: Insulated wire, 762,693 pesos (832,612 pesos); bare wire up to 10 mm., 253,386 pesos (235,523 pesos); armoured insulated cables, 495,700 pesos (442,479 pesos); "insulated metal cables and bare copper cable," 901,706 pesos (557,079 pesos); and insulators of glass, porcelain, &c., 222,336 pesos (278,432 pesos). (Peso=2s. approx.)

Mexican requirements of generating machinery and electrical supplies are catered for by branch houses of American works and by firms closely allied with German interests. One or two leading British manufacturers are represented in Mexico, but most of the business is in the hands of the Americans, who have spared no efforts to secure as much of the trade as possible from turbines to lampholders. Mr. Buxton says that although the prospects of immediate market development are not very favourable, the demand for electrical machinery, equipment and domestic appliances should improve as soon as the general outlook changes.

The Market for British Goods.

A section of the report is devoted to a consideration of this subject. Electrical goods are not specifically mentioned, but the repetition of one or two points may be useful. The British share of Mexican import trade has only averaged 7.8 per cent. over the seven years 1920-26. At present there is no immediate prospect of increasing this share substantially, but United Kingdom firms might do well to send representatives to study the market and, if necessary, appoint a local agent. Group representation might be worthy of consideration, but it is emphasised that nothing should be done until a thorough study of the market has been made. The Government prefers to place orders locally, and thus an agent in the country is of considerable advantage. There are certain classes of orders, mainly in connection with military supplies and locomotives, in which the United States is practically the sole supplier.

Transport and Communications.

Mexico City, Guadalajara, Vera Cruz, and Tampico are among the towns provided with tramway systems. The most important undertaking is that of the Mexican Tramways Co., which operates about 200 miles of track, and in 1925 conveyed 85 million passengers and a large quantity of goods. The tramways are meeting with severe omnibus competition, and special measures have been taken to deal with it.

The network of the National Telegraphs comprises some 50,000 miles of lines. Broadcasting is conducted through 15 private and five official stations, and is controlled by the Government. Although all receivers have to be registered, there is no fee or any restriction as to the type of apparatus. It is stated that 82,000 valve sets and 14,000 crystal sets are in use, and most of these are of American manufacture.

The capital and most of the larger towns are provided with telephone services. A long-distance system has been established between Mexico City and New York, and extensions to Canada and Cuba are contemplated.

The Electrical Trade of Holland.

THE following statement, showing the imports and exports of electrical and similar goods into and from Holland during the year 1927 is compiled from the recently-issued statistics. The figures for 1926 are added for purposes of comparison and notes of any increases or decreases are given.

Imports.

	Thous. Guilders. 1926.	Thous. Guilders. 1927.	Thous. Guilders. Inc. or dec.
Electric generators, motors, transformers and rotary convertors—			
Total	7,763	7,205	– 558
From Germany	4,488	4,148	– 340
,, Great Britain	1,008	959	– 49
,, Switzerland	1,016	556	– 460
,, Belgium	393	448	+ 55
,, United States ...	175	195	+ 20
,, France	336	427	+ 91
Electric locomotives—			
Total	60	163†	+ 103
Wireless apparatus—			
Total	3,434	4,817	+1,383
From Germany	1,234	2,360	+1,126
,, Great Britain	827	1,078	+ 251
,, France	600	444	– 156
,, United States	444	348	– 96
Telegraph and telephone apparatus—			
Total	4,263	5,579	+1,316
From Germany	2,682	3,214	+ 532
,, Belgium	536	520	– 16
,, Sweden	411	1,166	+ 755
,, Great Britain	274	226	– 48
Other electrical apparatus and instruments—			
Total	6,554	7,209	+ 655
From Germany	4,719	5,176	+ 457
,, Sweden	69	214	+ 145
,, Great Britain	578	529	– 49
,, United States	171	399	+ 228
,, Switzerland	714	567	– 147
Steam boilers—			
Total	5,754	5,769	+ 15
From Germany	2,219	2,310	+ 91
,, Great Britain	2,683	2,011	– 672
,, Belgium	538	524	– 14
,, France	225	528	+ 303
Electric cable, insulated—			
Total	8,013	9,902	+1,889
From Germany	7,004	8,221	+1,217
,, Belgium	549	911	+ 362
,, Great Britain	158	353	+ 195

	Thous. Guilders. 1926.	Thous. Guilders. 1927.	Thous. Guilders. Inc. or dec.
Steam engines and turbines—			
Total	2,867	2,836	− 31
From Germany	1,232	1,051	− 181
,, Great Britain	776	810	+ 34
,, Belgium	175	230	+ 55
,, Sweden	72	—	− 72
,, Switzerland	369	259	− 110
Exports.			
Wireless apparatus—			
Total	3,343	9,197	+5,854
To Germany	403	1,705	+1,302
,, Great Britain	747	1,346	+ 599
,, Dutch East Indies ...	285	285	—
Electric generators, motors, transformers and rotary convertors—			
Total	2,682	5,305	+2,623
To Germany	695	1,780	+1,085
,, Belgium	420	515	+ 95
,, Dutch East Indies ...	489	739	+ 250
,, Spain	148	322	+ 174
,, South Africa	261	177	− 84
,, Australia	83	191	+ 108
Telegraph and telephone apparatus—			
Total	594	758	+ 164
To Great Britain	301	318	+ 17
,, Dutch East Indies ...	51	*	—
,, Germany	109	120	+ 11
Other electrical apparatus and instruments—			
Total	1,526	2,792	+1,266
Steam boilers—			
Total	2,313	1,630	− 683
To Dutch East Indies ...	1,389	1,151	— 238
,, South Africa	186	13	− 173
,, Curacao	302	56	− 246
Insulated copper wire and cable—			
Total	3,277	3,438	+ 161
Metal filament lamps—			
Total	17,806	19,451	+1,645
To Belgium	1,299	963	− 336
,, Great Britain	1,112	1,853	+ 741
,, France	2,092	2,479	+ 387
,, Italy	2,181	2,067	− 114
,, Spain	880	263	− 617
,, Argentina	1,217	1,402	+ 185
,, Brazil	373	865	+ 492
,, Australia	1,567	1,692	+ 125
,, Dutch East Indies ...	572	785	+ 213
Steam engines and turbines—			
Total	1,910	2,037	+ 127
To Germany	217	90	− 127
,, Belgium	169	143	− 26
,, Dutch East Indies ...	895	1,103	+ 208
,, Italy	*	225	—

(Florin or Guilder = about 1s. 8d.)

*Not separately distinguished. †Mainly from Germany.

It will be seen that while Holland's exports of power plant have increased substantially, they are still below the level of imports. The latter, although rather less than in 1926, show a much larger total than in 1925. Costs were probably higher then, so that the increase between 1925 and 1927 is more than appears at first sight. From being in 1926 an importer of radio apparatus to a slightly larger extent than an exporter, Holland last year exported such apparatus to the value of over 9,000,000 guilder, while importing less than 5,000,000 guilders' worth. Of other telephone and telegraph apparatus as well as electric cable, Holland, however, is still a growing importer and a relatively small exporter.

Electrical Imports of Java and Madura.

Figures for 1926.

THE following statement, based on the recently-issued official statistics, shows the values of the imports of electrical and allied material into Java and Madura during 1926. In that year a new and more detailed classification was adopted; consequently an adequate comparison is not possible. Holland supplies the greater proportion of the Government's requirements, but Great Britain has a small share of the import trade on private account. The guilder is worth about 1s. 8d.

	1926. Thous. Guilder.
Electric lamps, incandescent—	
Total	868
From Holland	704
,, Germany	122
,, Japan	9
Electric cables—	
Total (private)	704
From Holland	321
,, Great Britain	—
,, Germany	332
,, Japan	9
Total (Government)	120
From Holland	115
Uninsulated and insulated electric wire—	
(a) of aluminium—	
Total (private) all from Great Britain	92
(b) of iron—	
Total (private)	33
Total (Government)	46
(c) of copper—	
Total (private)	1,050
From Holland	351
,, Great Britain	5
,, Germany	346
,, Japan	279
Total (Government)	301
From Holland	267
,, Germany	28
Materials for overhead transmission lines (including insulators)—	
Total (private)	404
From Germany	255
,, United States	29
,, Holland	90
Total (Government)	556
From Holland	400
,, Germany	136
Materials for electrical installations in buildings—	
Total (private)	466
From Germany	369
Batteries—	
Total (private)	119
From Germany	25
,, Denmark	20
,, United States	27
,, Japan	27
Total (Government)	76
Accumulators—	
Total (private)	202
From Great Britain	32
,, Germany	50
,, United States	89
Total (Government) nearly all from Holland	340
Wireless installations and apparatus—	
Total (private)	357
From Holland	171
,, Great Britain	33
,, Germany	130
Total (Government)	326
From Holland	233
,, Germany	53
,, Great Britain	21
Telegraph and telephone apparatus, &c.—	
Total (Government)	58
Total (private)	63
From Germany	35
,, Great Britain	12
Electrical installations and apparatus, unspecified—	
Total (private)	394
From Germany	269
,, Holland	81
,, Switzerland	16
Total (Government)	139
From Holland	103
Electric fans and ventilators—	
Total (private)	105
From Holland	11
,, Germany	57
,, United States	27
Dynamos, motors, transformers and rotary convertors, not elsewhere specified—	
Total (private)	1,113
From Holland	247
,, Great Britain	38
,, Germany	543
,, United States	225
Total (Government)	171
From Holland	83
,, United States	76
Automobile dynamos—	
Total (private)	29
Parts of dynamos, electric motors, transformers and rotary convertors—	
Total (Government)	19
Total (private)	152
From Germany	96
,, Holland	30
,, United States	10
,, Great Britain	10

Voltage Regulation Equipment.

Some descriptive notes on the apparatus developed by Messrs. Brookhirst Switchgear, Ltd., and Messrs. Ferranti, Ltd.

The "Brookhirst" Equipment.

In 1919, Messrs. Brookhirst Switchgear, Ltd., first became interested in the problem of meeting the demand for apparatus for the regulation of the voltage or the load transmission on large systems, and they decided in favour of the separate regulator for this work.

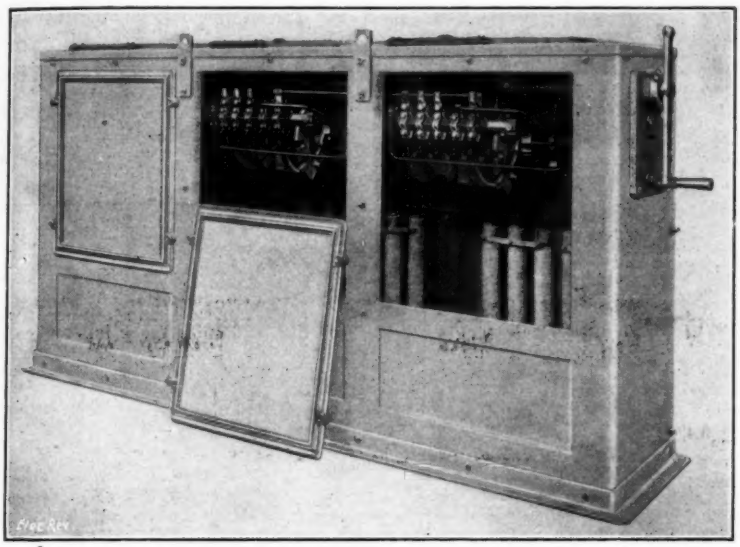


Fig. 1.—600-V Drum-type Regulator.

The design first completed was of the multiple-switch or cam-operated-contactor type, but its limitations were quickly realised. Various considerations, coupled with an appreciation of the objections to cam-operated contactors or oil switches, led to the decision to adopt the drum design. The advantages of this type of regulator were generally discussed in an article by Mr. G. Rattenbury in the Electrical Review of April 3rd, 1925.

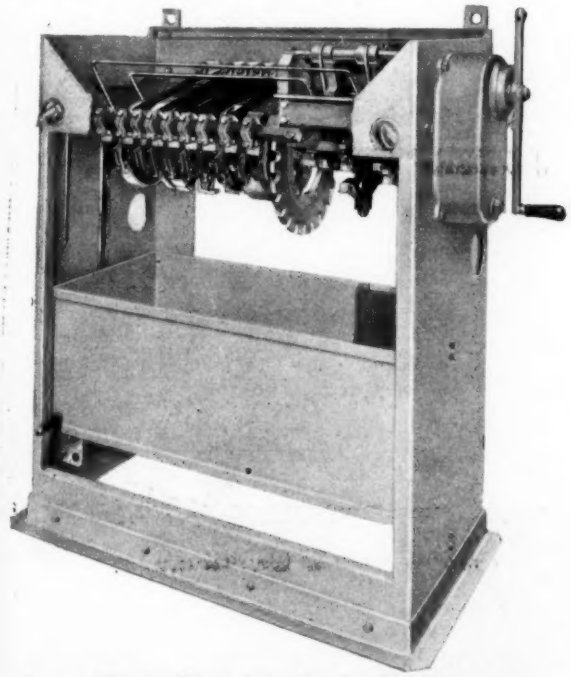


Fig. 2.—Drum Apparatus for 3.000 V.

The drum-type regulator is usually arranged with a buffer circuit embodying either a self-contained buffer resistance, or a separate intermittently rated choking coil, but when more than five regulating positions in either direction are required, a modification of the gear permits of the use of preventive auto-transformers, thus obtaining twice as many steps. The drum is usually arranged to reverse the direction of boost, and by this means it is possible to obtain twenty regulating steps from a five-section transformer. The design is primarily intended for connecting on the booster system, but within certain limitations of voltage and current the regulators can be connected directly to the main transformers. Each single-phase unit consists of three distinct, but mechanically connected switches operating successively in the required sequence. These are a drum-type tapping selector and reversing switch, which, it is claimed, is not subjected to any arcing whatever, and therefore should need no adjustment throughout a reasonable life, and which also provides the two independent circuits necessary to permit of changing over without interrupting the main circuit, and two quick-break drop-type diverting or auxiliary switches, with easily renewable and butt contacts specially designed for circuit breaking. The movement of the drum and auxiliary switches is intermittent, but without shock, and ensures the interruption of each circuit on the auxiliary switch before the drum moves, thus preventing by slow motion any chattering on the drum contacts. The drum is positively locked in the correct positions.

The method of operation, which may be direct, remote or automatic, can easily be altered even after installation. Hand operating gear is arranged to make one or a half revolution per step, and is provided with a spring notching arrangement to ensure the correct location of the drum on its contacts. Access to the working parts of the oil-break regulators can be gained by the removal of the top cover and lowering the oil tank by means of self-sustaining gearing provided. For the l.p. air-break regulators hinged glazed doors are supplied.

In the case of equipment of large capacity and for high voltages, inspection of the arcing contacts is facilitated by placing the two auxiliary switches in a separate oil tank. Figs. 1 and 2 show respectively 600-V and 3,000-V drum-type regulators.

Fig. 3 shows the motor-operating gear. An interesting feature is that the completion of any movement of the regulator which may have commenced, even if the electrical supply fails, is effected by means of a falling weight. The regulator will then remain in the same position until the supply is restored. The movement is arranged to secure the correct location and locking of the regulator on its contacts. The

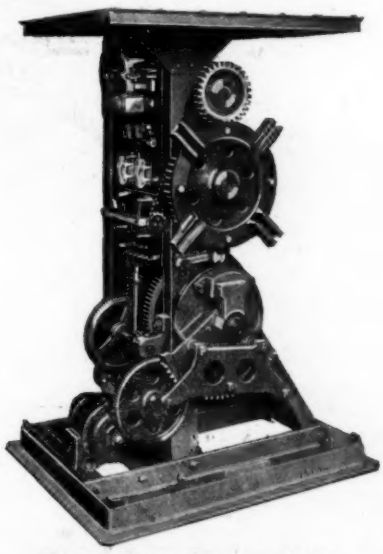


Fig. 3.—Motor Operating Gear.

operating current may be either d.c. or a.c., but where an auxiliary d.c. supply is available this is usually preferred. The equipment is arranged for emergency operation by hand in the event of a failure of the supply to the auxiliary motor, or even if the complete motor-operating pillar is removed.

For interlinking schemes the experience of operating engineers suggests that it is usually undesirable, even in emergency, to throw a big load suddenly from one system to another, and a reasonable time delay gives the attendant an opportunity for consideration and for observation of the results. The time required to raise the weight after each movement gives sufficient delay to prevent panic operation. The time delay necessary with automatically controlled installations to discriminate between momentary fluctuations and permanent changes is taken care of by suitable delay relays. The electrical operation is arranged to be effective even with variations in the supply voltage, up to 25 per cent., up or down.

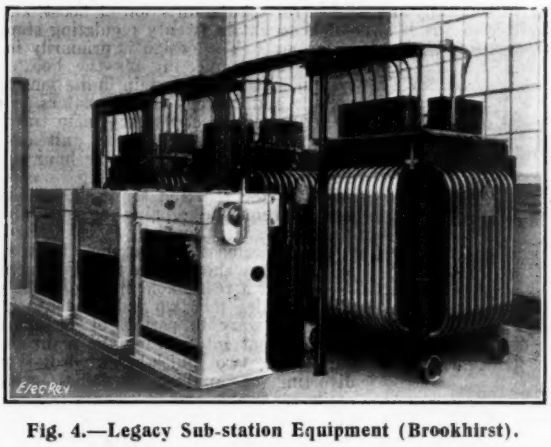


Fig. 4.—Legacy Sub-station Equipment (Brookhirst).

Fig. 4 shows the transformer and drum-type regulating equipment at the Legacy sub-station, 4,000-kVA, 33,000 V, of the North Wales Power Co., Ltd.

Oscillograph tests made on a regulator working in connection with a 5,000 kVA, 6,600/2,200-V Scott-connected transformer giving 1½ per cent. steps, and provided with a differ resistance, show no appreciable surges when the regulator is moved from step to step throughout its range. Fig. 5, reproduced from the oscillograph curves, shows the effect of changing from one tapping to another.

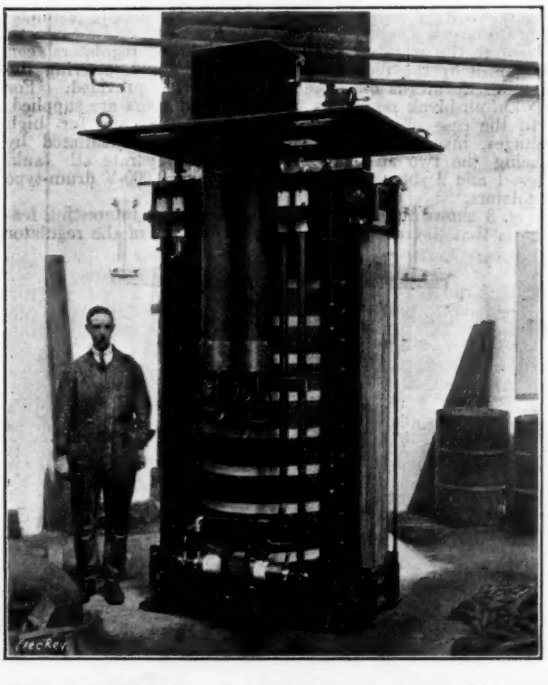


Fig. 6.—4,000-kVA Ferranti Transformer, showing Tapping Switch.

Regulation on small feeders can frequently be done most effectively by a simplification of the faceplate-type regulator with connection to the star point on the l.p. side of a three-phase, four-wire system. Such regulators installed in isolated sub-stations would generally require to be automatically controlled, and for this purpose a robust design of voltage relay and a simplified motor operating gear are available.

The "Ferranti" Method.

With every arrangement of tap-changing on load it is necessary to provide two circuits, one of which carries the full load while the tappings on the other are being altered. If parallel circuits are employed which normally share the load and have inherently the necessary reactance to limit the circulating current during the change-over period, no additional apparatus need be provided.

The Ferranti method of using parallel circuits contains distinguishing features in (*a*) the arrangement of the tapping switch, and (*b*) the arrangement of the mechanical drive.

Hitherto the disadvantage of the parallel-circuit method has been the difficulty of bringing out and insulating the many connections from the h.p. winding. This objection has been entirely overcome, it is claimed, by the use of the patented Ferranti tapping switch, which is mounted inside the transformer adjacent to the tapped coils, as shown in fig. 6. The connections to the switch contacts are extremely short, and the cost of cleating is thereby reduced to a minimum. As the switches do not break any load current there is no danger of carbonisation of oil taking place in the transformers. The series switches are quick-break, oil-immersed and equipped with sparking contacts, the speed of opening being independent of the rate of operation of the gear. They are contained in sheet-steel tanks mounted on the transformers, as shown in fig. 7. The main transformer connections are taken through bushings in the side of the transformer tank direct to the switches, thus keeping all the connections under oil. Gear is provided for lowering the oil switch tanks to facilitate examination of the switch contacts.

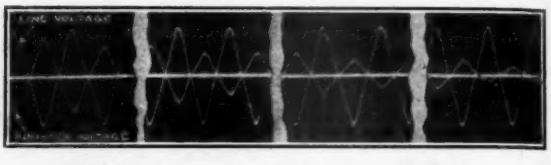


Fig. 5.—Oscillograph Change-over Curves.

Any tendency to burning of the contacts and carbonisation of the oil is very small since, owing to the clearances necessary for the line voltage, the breaking capacity of the switches is very much greater than the kVA which they actually have to deal with, the latter being generally of the order of 2 per cent. of the full load. Inspection covers are provided to give easy access to the connections to the series switches, so as to allow of their disconnection when it is desired to remove the transformer from its tank.

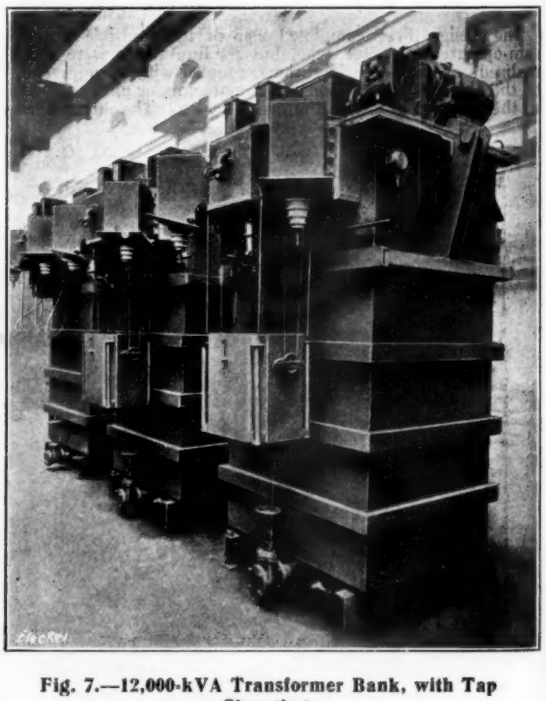


Fig. 7.—12,000-kVA Transformer Bank, with Tap Changing.

The difficulty in the operation of the selective switchgear of obtaining rapid completion of one definite cycle, coupled with the avoidance of over-shoot, has been overcome by the introduction of a simple form of intermittent gearing which leaves the motor free during the starting and stopping period without introducing any shock when it commences to drive the mechanism. The mechanical gear for operating the switches

in the correct sequence is contained in a weatherproof casing which is mounted on the cover of the transformer tank, the cover, together with the transformer, being arranged to be lifted out as one unit. Access to the interior of all portions of the mechanism is provided by removable covers, and the whole of the gear runs in oil baths and can be made suitable for outdoor operation.

Where the energy of the main circuit is not transformed at a point suitable for regulation, or where the line current is either too small to make parallel circuits in the main transformer advisable, or is so large as to require the use of costly switchgear, it is preferable to use a regulating transformer and booster. In such cases parallel circuits cannot be used on the tapped winding owing to the large changes of reactance which take place as steps are cut in and out. The primary winding of the boosting transformer can, however, be dealt with accordingly by the Ferranti method. The equipment can be operated by hand direct or by remote electrical control, and it can also be made suitable for automatic operation.

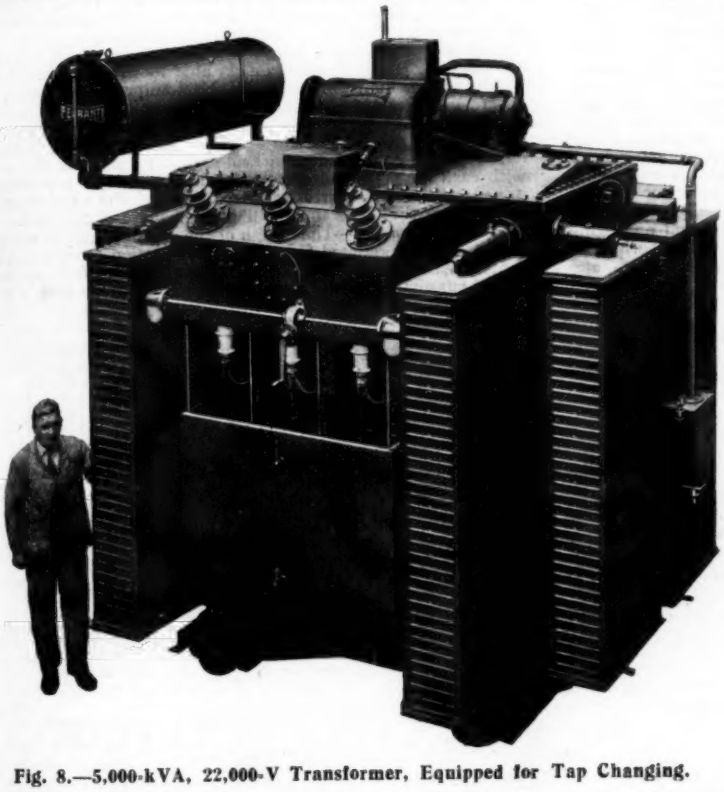


Fig. 8.—5,000-kVA, 22,000-V Transformer, Equipped for Tap Changing.

Fig. 7 shows one of three 12,000-kVA transformer banks, 10,500-22,000-V, delta-star, recently supplied to the London Power Company. The voltage ratio is changed on load to give a boost of 8 per cent. (on 22,000 volts) in steps of 2 per cent. each. The banks are remote electrically controlled, and since the transformers operate in parallel, means have been provided for the simultaneous operation of the three banks from one controller. The control switch is a hand-operated, rotary device, having a contact corresponding to each tapping position. If the switch is moved to a fresh position the control relay immediately causes the tap changer to follow the control switch to the new position. The simultaneous operation of the tap-changing equipments is ensured by the use of a common control switch, but to allow of individual operation, coupling switches are also provided on the control panel to enable the control circuit of any one bank to be put out of action. By closing the coupling switch before a bank is switched in, the mechanism ensures that it will take up the same position of boost as the other bank or banks with which it has to operate in parallel.

Remote indication of the tapping position is given on the control panel, the indicator taking the form of a voltmeter supplied from the control auxiliary circuit through a potential divider operated by the tap-changing mechanism.

To provide against failure of the auxiliary supply preventing the tap-changer from completing the full movement and thus overloading a portion of the winding, differential current transformers are installed in the parallel connections at the bottom of each limb, fig. 6. Fig. 8 shows a 5,000-kVA, 3-phase, 22,000-V transformer with tap-changing equipment recently supplied by Messrs. Ferranti to the Ayrshire Electricity Board.

An important order has recently been put in hand by Messrs. Ferranti for the Central Electricity Board (Central Scotland Electricity Scheme, 1927) comprising five 30,000-kVA and eight 20,000-kVA, three-phase, 132,000-volt transformers. These are to be provided with means for changing the tappings on load, the mechanism being remote controlled and suitable for automatic operation if desired.

South African Railway Electrification.

The 171-mile Pietermaritzburg-Glencoe section of main line in Natal, designed on the d.c. 3,000-volt system to carry 30,000 tons of goods per day in one direction, together with 1,500 tons of passenger traffic.

By F. LYDALL, M.I.E.E.

(*Extracts from paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THAT section of the South African railway system which the Railways and Harbours Administration has electrified between Glencoe, in the north of Natal, and Pietermaritzburg, in the south, forms part of the main line which connects Durban with the Transvaal. Glencoe is approximately the centre of the Natal coalfields, and a large proportion of the traffic on this line consists of coal consigned to Durban for bunkering and export.

With many sharp curves and steep gradients, starting from Glencoe (4,310 ft. above sea-level) the line falls to Ladysmith (altitude of 3,190 ft.), climbs to Estcourt (3,830 ft.), and then over a pass, the highest point of which is 4,980 ft.; it then falls until Pietermaritzburg is reached at 2,210 ft. The sharpest curve is of 300-ft. radius and there are very many curves of 573 ft. and 716 ft. radius; hilly rolling country is responsible for the large amount of curvature. The gauge is 3 ft. 6 in. In winter the climate is dry and moderately warm during the day and cold during the night; during the summer (November to March) the temperature is high and there are tropical rainstorms and very severe lightning storms.

The complete electrical system consists of the power station, generating 3-phase 50-cycle current at 6,600 volts stepped up to 88,000 volts; a high-voltage transmission system; 12 sub-stations, situated at an average spacing of about 15 miles, 11 of them being supplied at 88,000 volts and one (at Colenso) fed direct from the power station; an overhead contact line for distributing power from the sub-stations at 3,000 volts (d.c.) to the trains; and the electric locomotives, fig. 1.

Power Station.—The site is at Colenso where the railway crosses the River Tugela, of which the minimum recorded flow was about 30 cu. ft. per second, whereas during times of maximum flood the level of the river may rise by 30 ft., and the rate of flow may be as much as 100,000 cu. ft. per sec. In order to secure an adequate supply of cooling water to the condensers during the dry season, it was considered advisable to build a small weir about 8 ft. 6 in. above the river bed to form a cooling pond.

On the basis of the traffic for which provision had to be made, and an assumption as to the demand for power for general and industrial purposes over the area served by the transmission system, it was decided to install five 12,000-kW turbo-alternators, one of which might be standing by and the other undergoing overhaul; each set was designed to deal with a 2-minute overload of 20,000 kW. The turbines have tandem

high- and low-pressure cylinders and twin condensers, and are so arranged that, in the event of the power station being shut down at any time, they can be started again without any extraneous supply, such as is usually provided by "house" turbines. The load on the generators therefore includes that of the auxiliaries, so that the estimated sustained maximum was about 33,000 kW. The river bank was cut back into a bay in which the screen and pump chamber was built: on two successive occasions the river came down in very heavy flood with an enormous amount of suspended matter and the station had to be shut down until a channel had been cut through a deposit about 25 ft. deep. To overcome the liability to block the intake in this way, it was decided, after consultation with Mr. Kanthack, formerly director of irrigation to the South African Government, and with the chief civil engineer of the Railways and Harbours Administration, to build a new regulator chamber with six separate compartments, each with its own screen and a sluice gate to control the level at which the water is admitted, depending upon the condition of the river bed. Also the weir was replaced by a barrage lower down the river which has the same effect in forming a cooling pond, but provides by means of sluice gates for scouring out the bed of the river in times of flood.

The eight 60,000-lb. boilers, one standing by and one being overhauled, work at 275 lb. per sq. in., with superheaters (700 deg. F.), chain-grate compartment stokers, forced- and induced-draught fans, air heaters, feed-water heaters and steam-driven feed pumps. Coal is distributed by belt conveyors, and the ashes are removed by "Usco" plant.

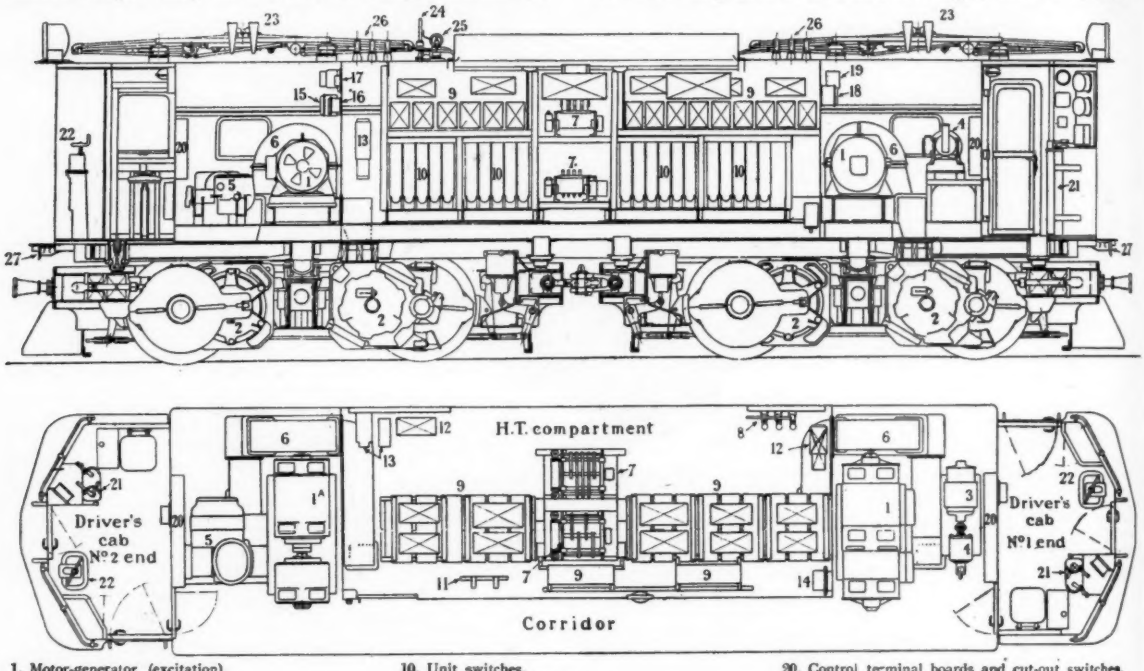
The electrical equipment includes five unit and four power-station transformers, auxiliary motors, the main 6,600-volt switchgear of the ironclad type, and an outdoor sub-station consisting of five 13,500-kVA transformers stepping up from 6,600 to 88,000 volts, with the necessary high-voltage switchgear and lightning arrestors; the control of the whole of the switchgear is centralised.

Transmission Lines.—Designed for a pressure of 88,000 volts, four lines radiate from the power station, two north towards Glencoe and two south towards Pietermaritzburg: each consists of three 0.125 sq. in. copper conductors supported in a horizontal plane on single-circuit towers. In order to maintain the lines as free as possible from trouble due to lightning storms, it was decided to separate the two single-circuit lines in each direction north and south by not less than about half a mile. The two lines were also kept away from the railway so as to avoid interference with the open telegraph and telephone lines which run close alongside the track. Each of the two lines feeding north and south is teed off at the sub-stations, thus providing a duplicate supply.

Sub-stations.—In view of the density of the traffic and the importance of working as nearly as practicable to schedule speeds so as to facilitate the crossing of trains on the single-sections of the line, sub-stations are located about 15 miles apart and they are alternately single- and double-unit, each converting set consisting of a synchronous motor with two 1,500-volt d.c. generators connected in series and two exciters, one for the synchronous motor and the other for the generators, and equipped with automatic control apparatus which enables all operations to be carried on without the services of sub-station attendants. As it was anticipated that the motor-generators would work almost continuously throughout six days of every week, it was thought better to put their control in the hands of adjacent signalmen or stationmasters who, on telephone instructions from the control room at the Colenso power station, could, by a small switch, shut down or start any set, or switch over any set from one transmission line to the other.

Each motor-generator is continuously rated at 2,000 kW, or 667 amperes at 3,000 volts, and is able to give an output of 2,000 amperes for 5 minutes, and 2,300 amperes momentarily. In order to avoid the tripping of the circuit breakers due to an excessive demand caused by the simultaneous starting of two trains in the immediate neighbourhood, a motor-operated field rheostat controlled by a load-regulating relay is provided with each motor-generator. If the output exceeds a predetermined value the d.c. pressure is reduced and the adjacent sub-stations are thus able to take a greater share of the load.

Track Equipment.—The design of the overhead line is similar to that already adopted for other electrification schemes. The contact wire throughout has a sectional area of 0.25 sq. in.; for all running lines the catenary is a copper cable with a sectional area of 0.375 sq. in., so that the area of the catenary and the contact wire combined is 0.625 sq. in. On both sections of the line where more copper is required, it is provided by means of supplementary feeders of two sizes, *viz.*, 0.375 sq. in. and 0.25 sq. in. In addition to the contact catenary and feeders, a 0.15-sq. in. copper wire is clamped to each structure and connected at intervals to the rails to provide continuity in the rail return-circuit in the event of this being broken at any time due to rail replacements or other causes. All wires are carried by "diabolo" porcelain insulators on lattice steel structures.



1. Motor-generator (excitation).
1A. Motor-generator (supply).
2. Traction motor.
3. Exhauster.
4. Exhauster motor.
5. Air compressor.
6. Blower (driven by motor-generator).
7. Cam-operated switch groups.
8. Auxiliary fuses.
9. Resistance banks
10. Unit switches.
11. Main isolating switch.
12. Motor generator starting resistances.
13. Motor generator contactors.
14. Over voltage relay.
15. Compressor starting switch.
16. Battery switch.
17. Battery resistance.
18. Exhauster starting switch.
19. Exciter contactors and resistances.
20. Control terminal boards and cut-out switches.
21. Master controller.
22. Hand-brake column.
23. Pantograph current collectors.
24. Lightning arrestor.
25. Choke coil.
26. Pantograph isolating switch.
27. Electrical couplers.

Fig. 1.—Main-line Electric Locomotive as used in Natal, South Africa.

Locomotives.—The limit of steady draw-bar pull was taken as 60,000 lb., and the maximum train weights were limited to the following:—

From Glencoe to Daimana	1,640 tons.
From Daimana to Pietermaritzburg ...	1,430 tons.

A locomotive (or a set of locomotive units) was to be capable of (*a*) hauling a train of 1,500 short tons up a gradient of 1 in 100 at a speed of 21 or 22 miles per hour and of hauling the same train on a level tangent track at not less than 36 miles per hour; (*b*) holding a train of 1,640 short tons on a falling gradient of 1 in 50 by regenerative action alone (the speeds being determined principally by the curves and the necessity of passing through stations at not more than 15 miles per hour); (*c*) taking a train of 1,430 short tons from Ladysmith to Pietermaritzburg in 7 hours 7 minutes with six

intermediate stops totalling 52 minutes, or a train of 700 short tons from Pietermaritzburg to Ladysmith in 7 hours 27 minutes with 13 intermediate stops totalling 101 minutes. The capacity on the one-hour rating of the motor equipment was fixed at 3,600 h.p. With 12 driving axles or six 2-axle bogies a full-weight train is hauled by three locomotive units coupled together, each unit consisting of a body carried on two articulated bogies, and each axle being geared to a 300-h.p. motor; the equipment of a set of locomotive units therefore consists of twelve 300-h.p. motors. All locomotive units are designed to enable four units to be coupled up and controlled simultaneously from any master controller, whether hauling or working regeneratively. All classes of traffic, whether freight or passenger, are hauled by the same locomotives, the number of units depending upon the weight of the train. Thus the heaviest freight trains are hauled by three units, lighter freight and through passenger trains by two, and local passenger trains by a single unit.

Telephone Communication.—The general control of the electrical system is effected by telephone instructions from the control engineers at Colenso, who occupy the same room in the power station as the switchboard attendant, so that the co-ordination of the whole electrical system is facilitated. There are two independent selector systems, one of which is normally utilised for communicating with signalmen and stationmasters who are connected with sub-station operation; the other connects up all the railway stations along the line with the traffic controller in Ladysmith and the control engineers at Colenso.

For communication between the trains and the traffic controller or the control engineers at Colenso, all drivers are provided with a portable telephone set and a pair of hook-sticks.

Electricity Supply Commission.—The Commission now owns and operates the power station, transmission lines, and sub-stations, and is responsible for the supply of power to the Railway Administration for traction and other purposes. Provision has been made in the sub-stations at Pietermaritzburg, Estcourt, Daimana and Glencoe whereby supplies of power at 6,600 volts can be given to municipalities and other consumers, and although at present these supplies are comparatively small, they are the first fruits in this area of the policy for the carrying out of which the Commission was appointed, *viz.*, to make available, so far as possible, throughout South Africa a cheap supply of power at a reasonable price wherever it may be required.

Operating Experience.—On a single line with the characteristics described above, it was only to be expected that the substitution for steam locomotives of electric locomotives with a practically unlimited supply of power on which to draw should lead to a very considerable improvement in the working of the traffic.*

The reduction effected in the working expenses by the improvement in traffic working, especially with regard to the wages of the train crews, is substantial; with the steam-operated traffic the average time on duty of train crews was about 15 hours, and overtime payment was therefore very considerable; this has been greatly reduced by electric operation. The energy consumption per ton-mile gradually fell, the final figure being 45.6 watt-hours (or 45.6 units delivered to the sub-stations per 1,000 short ton-miles). During this period regenerative working was being gradually introduced. A special test was made with a down train of 1,500 tons and an up train of 800 tons, both hauled by three electric units, to ascertain the amount of energy regenerated during a round trip from Glencoe to Pietermaritzburg and back. The input to the main motors was about 15,200 units, and the output from the motors about 4,800 units. In attempting to estimate the value of this regenerative working, due allowance must be made for losses in the exciters and other auxiliaries on the locomotives, the distribution line, and the sub-stations. Such losses can hardly be less than 20 per cent. of the output from the motors, but even assuming 25 per cent., the energy made available by regeneration on goods trains alone with a daily coastwise traffic of 30,000 tons (excluding Sundays), would be about 22¼ million units per annum. Failing regeneration, the whole of this energy would have to be dissipated by the brakes on the locomotives and the trucks.

With traffic consisting mainly of a few very heavy goods trains and working only approximately to time-table, the fluctuations are likely to be considerable, with heavy demands continuing over considerable periods. For example, the load on the power station due to a 1,500-ton train travelling over the bank from Estcourt to Mooi River, is approximately 3,500 kW for about 40 minutes, changing within 40 seconds to a negative demand of about 900 kW. For deciding upon the equipment of the power station it was assumed that the half-hour maximum demand, for traction alone, corresponding to the full traffic of 30,000 tons per day would be 24,000 kW, which gives with the estimated consumption a daily load factor of between 75 and 80 per cent. Coal consumption at the power house varies from 1.89 to 1.66 lb. per kWh sent out (thermal efficiency from 15.6 to 16.6 per cent.) and it will be understood from the character of the load that; although the load factor on the basis of the half-hour maximum is high, the sudden and wide fluctuations in the demand are not conducive to very high economy.

Transmission lines have given very little trouble in service. There have been a number of cases in which one or other line has been cut out, but on very few occasions, and then only for a very short time, have both lines been out at the same time. There have been, however, quite a number of temporary faults: in the worst month 18 were attributed to birds and 11 to lightning. In only one case, however, has there been a sustained fault which made it impossible to reclose the circuit breakers immediately.

The most interesting experience with the track equipment is the trouble that was caused by lightning during the early days of electric operation. In Natal the lightning storms during the summer may perhaps be more severe than on any other electrified line, and certainly their effect on the overhead equipment during the first two summers was such as to cause some dislocation of the service. Experience showed that some definite scheme of protection was necessary to prevent the breakdown of the overhead-line insulators during the frequent lightning storms. The trouble generally showed itself in the following way: due to a lightning discharge in the neighbourhood a momentary high pressure was induced in the overhead line sufficient to cause a flash-over to earth from the live fitting on a pull-off insulator; following this flash-over a 3,600-volt short-circuit was established, the arc of which burnt out the insulator clamps and allowed the pull-off rod to fall free and hang suspended from the contact line, remain alive, foul and damage the pantograph of the first locomotive that came along, unless the driver was able to pull up in time, in which case the train was held there until the pull-off arm had been removed.

To guard against this, it was at first proposed to install lightning arresters, but the solution of the problem was ultimately found in the adoption of high-speed automatic circuit breakers for sectionalizing the line at every sub-station. The effect of any flash-over and the subsequent 3,000-volt short-circuit is now to open the breaker at each end of the section affected; the arc is thus cut off before it has time to do any serious damage, and the line is made alive again by reclosing the circuit breakers.

The electric locomotives have fulfilled all requirements and are capable of dealing with loads rather heavier than those specified. The 78 units originally provided to deal with a daily traffic of 20,000 tons towards the coast, plus the passenger traffic, have on occasions dealt with more than 25,000 tons. With 17 additional units, making 95 in all, a total of 34,000 tons, including the passenger traffic, has been worked successfully over the electrified section. Regenerative braking has proved quite satisfactory.

The parts of the electrical equipment which came in for most criticism were the 3,000-volt motors of the two motor-generators which operate the auxiliaries and control gear on the locomotives: until steps had been taken to eliminate the causes, they were very liable to flash-over from brush to brush, or from brush to ground, due to broken wires, high commutator segments owing to shrinkage of mica, and brushes sticking in the brush holders. Trouble caused by the breakage of truck couplings and draw-gear has been greatly reduced, partly due to the more skilful handling of the locomotives by the drivers, and probably in part due to the elimination of a good many weak or flawed draw-bars. These breakages reacted on the electrical equipment of the locomotives, especially on the main resistances.

The 78 locomotives have worked considerable mileages per annum: in a year one ran 80,475 and several did over 75,000, the lowest figure being 50,828 miles.

[The paper was illustrated with lantern slides and a kinematograph film taken in South Africa.]

*See ELEC. REV., Feb. 25th, 1927, p. 324.

Discussion in London.

Mr. R. T. SMITH thought the reasons stated for choosing the d.c. system were conclusive. A leaf might be taken out of the author's book with respect to the extraction of condensing water from the Thames for the new stations to be built in London: the problem was one of irrigation, not engineering, and trouble at Colenso had had to be remedied with the assistance of an irrigation engineer. A feature of the paper was that the operating conditions were so fully stated. The electric locomotives had made a very fine performance; when main lines were electrified in England that type of locomotive would be used for all goods and slow traffic. As there was so little in the paper that could be criticised, the speaker introduced an element of controversy by referring to commutator design, *i.e.*, the practice in this country (borrowed from America) of using few wide slots in preference to the Continental use of many narrow ones. While it was true, he said, that wide slots gave a greater output, they could not work so well as narrow slots, and needed special features to enable them to operate well. Railwaymen should not perpetuate a fashion for manufacturers' competitive reasons.

Mr. C. H. MERZ pointed out that because the railway was narrow-gauge it must not be considered that the electrification scheme was a small one, for the trains were heavier, and other conditions in South Africa were very different to those obtaining in England. At the time the scheme was designed the prospect of utilising automatic sub-stations was by no means so good as it was now; the thinly-populated country, lack of roads, &c., made the provision of station attendance, when required, far from simple. The general desire had been for simplicity throughout, in the power station, lines and locomotives, and the work had been approached logically from the economic point of view: in all such cases it was wrong to stipulate steam conditions; provision should rather

be made for carrying the traffic that offered itself without duplicating the line. The scheme proved the contention that railway electrification did not pay where coal was cheap to be wrong, for coal was obtainable at the South African mines for 2s. 6d. per ton. By making power transmission lines available, the railway conversion scheme had resulted in the appointment of the Electricity Supply Commission; in this country it was the other way round.

Mr. P. S. TURNER said the scheme reflected great credit on the British consultants and manufacturers, for it was the first instance of their having tackled a 3,000-volt d.c. scheme. The utilisation of three locomotives to draw a heavy train appealed to him, for it allowed the power to be adjusted to suit the load, and provided against individual breakdown. It was curious that those features which caused most anxiety during the design stage gave least trouble in service; the draw-gear trouble had not been foreseen, and the 3,000-volt d.c. system worked well on the whole.

Lieut.-Col. H. E. O'BRIEN welcomed the paper as being the first complete description of a scheme of any magnitude, and it should therefore not fail to convince railway authorities. Moreover, the system was not fed with cheap power from hydro-electric plant, but with coal at a price which was comparable with that ruling in England and Northern France, namely, 9s. per ton delivered at the gener ting station. The mileage run per locomotive per year was very high, but he thought that even higher figures were possible: some of the locomotives must have run 250,000 miles by now, and it would be instructive to know what repairs they had needed; after covering such a mileage as that a steam engine would require a new boiler at least. A central corridor through the locomotives would afford drivers a better view when backing. Not commutator faults, but armature breakdowns were the most prevalent, and were due to the use of insufficient binding wire.

Lieut.-Col. F. A. CORTEZ LEIGH thought that convincing reasons had been stated for the adoption of 88,000-volt transmission lines and 3,000 volts for traction; indeed, that system might almost become the standard. The transmission lines seemed to be sectionalised at two places; a looped-in system might have diminished the trouble caused by lightning, &c.

Mr. E. H. CROFT was of the opinion that, in the case of heavy freight trains it was advisable to couple the locomotive driving wheels in order to obtain greater adhesion. Had any trouble been experienced due to one pair of wheels slipping when regenerative braking was applied? Was any definite information available about the effectiveness, or otherwise, of connecting rotary-convertor fields partly on the positive side and partly on the earthed side, as a means of choking reflex surges following short circuits?

Mr. W. M. MORDEY asked why d.c. had been adopted in preference to the single-phase a.c. system. There was an uncertain sound about such statements as "considered *at that time* undesirable" and "available estimates *at that time*"; would considerations be different to-day?

Mr. H. BRAZIL said it was a red-letter day when high-speed circuit breakers were put into commercial use for railway work. They were very valuable for protecting machines against flash-over, but in a test he had carried out he found that a high-speed breaker required one second to open after its holding-on coil had been short-circuited; was that time interval satisfactory? Were the oxide-film lightning arrestors installed on the S.A. railway system any use at all, and, if so, how?

Mr. F. LYDALL intimated that he would reply to the discussion in the I.E.E *Journal*. As an indication of the beneficial results of the conversion he mentioned that formerly the steam service needed 300 drivers, 300 firemen, and 300 guards to operate it, whereas the electric service was run by 85 drivers and 85 guards.

The National Physical Laboratory.

Extracts from the Annual Report of the Executive Committee for 1927.

AS was expected, the annual report* on the work of the National Physical Laboratory during 1927 is a record of continued activity in all departments. The external demand on the Laboratory for work for which payment is received materially increased, and in some departments it necessarily reduced the time devoted to the more fundamental research.

Compared with 1926, the number of tests carried out, excluding clinical thermometers (536,636), decreased by 2,827 to a total of 43,130; the Electricity Department made 2,560 tests, an increase of 61.

The need of a new physics building continued to hold a foremost place; funds therefore were voted by Parliament in 1925, but the work was stopped on the ground of national economy; provision for the commencement of the building was to be included in the estimates for this year. The installation of the million-volt transformers in the high-voltage building was to be completed early in 1928; at the International Electric Conference at Bellagio in 1927 the standardisation of voltages for power transmission was considered, and the German representatives called for the inclusion of a standard voltage in excess of 300,000 V.

A number of international meetings and conferences held in 1927 dealt with matters in which the N.P.L. is closely interested. At its Paris meeting the Commission Internationale des Poids et Mesures was authorised, and steps were taken, to aid the intercomparison of electrical units and the co-ordination of electrical measurements on an international basis. At the meeting of the Union Radio Scientifique Internationale at Washington it was agreed, for the purpose of comparing different methods of measurement, to continue intercomparison of frequency standards by the circulation of piezo-oscillators and resonators; the American Bureau of Standards had already sent oscillators to a number of national laboratories, and the N.P.L. is to circulate resonators to form an independent link. In co-operation with the Board of Trade, the N.P.L. complied with the request of the Council for Scientific and Industrial Research of the Commonwealth of Australia for advice and assistance in the establishment of standards of measurement in Australia in agreement with those in use in this country. Professor Madsen, chairman of the Standards Committee of the Commonwealth Council, spent some weeks in England in order to consult with the authorities concerned; as chairman of the Radio Research Committee of the Commonwealth Research Council, he also took special interest in the wireless research in progress.

In the Physics Department, Heat Division, the outstanding item was the work done towards the establishment of the temperature scale, including the preliminary determinations of the melting point of palladium with the aid of a high-frequency furnace; the investigation of the thermal and electrical conductivities of alloys is being extended to temperatures up to 1,000 deg. C.

In the Radiology Division work for the Committee on Industrial Applications of X-rays was directed mainly to the study of magnetic steels and the effect on them of heat treatment, and to the investigation of the effect of rolling on the structure of metals and alloys; a contribution towards the cost of this work was made by the British Electrical and Allied Industries Research Association.

Much time was spent during the year in work relating to the electrical units and standards, and a number of intercomparisons were made with other national laboratories. Apparatus was under construction for a determination of the ohm (absolute) in terms of mutual inductance and frequency by the alternating current method devised by Mr. Albert Campbell, and the general consistency of inductance and capacity measurements was improved.

Work on standards for measurements at radio frequencies done for the Radio Research Board by quartz piezo-electric oscillators resulted in a mean variation from the mean of all the measurements not exceeding three parts in one hundred thousand. The modes of vibration of quartz oscillators and resonators were studied by the observation of the optical interference patterns obtained when light is reflected at the quartz surface after transmission through a parallel glass plate; the nodes and loops in the vibrating surface can thus be determined. Much attention was also given to the design and construction of a special form of Schering bridge for the measurement of effective resistance at radio frequencies, whether in condensers, inductances, or in circuits of various kinds.

Important improvements were made in the methods of testing magnetic material, especially under low magnetising forces, and interesting results were obtained as to the effect of mechanical and heat treatment of the material; very high permeability, with small hysteresis loss, was obtained for samples of very pure iron, though large differences, as yet unexplained, were found between samples of equal chemical purity. The work of the Standards Division included an investigation for the British Electrical and Allied Industries Research Association into the dielectric losses in varnished cloth, work on the dielectric properties of ebonite and other insulating materials, and measurements of the inductance of steel-cored aluminium cables.

Apart from tests and investigations for which payment was received, work in the Electrotechnics Division during the year was mainly directed to the improvement of methods and equipment for measurements of various kinds, and preliminary work was done on corona discharge from high-voltage power lines, and on transmission losses when three-phase power is

* H.M. Stationery Office, price 7s, 6d. net.

carried by three separate cables, in view of the importance of these problems to the Electricity Commissioners.

The manganese-nickel-copper alloy "Ohmal," of manganin type, developed at the Laboratory some few years since, has shown very satisfactory constancy of resistance over a period of years, and was used in the construction of a series of standard resistances of the highest quality, in which special features were embodied; a method of compensating for temperature changes was employed. New methods were introduced for the measurement of power in circuits carrying alternating currents of the order of 5,000 amperes, involving the use of current transformers in which advantage is taken of the magnetic properties of "Permalloy" to obtain a secondary current closely proportional to the primary, and nearly 180 deg. out of phase with it. Apparatus on the same principle for the testing of voltage transformers is being investigated.

The Photometry Division reports that various national laboratories have undertaken a joint investigation, in accordance with a programme arranged by the International Illumination Commission, to examine different methods of photometric comparison of light sources of different colour. A comprehensive investigation into the effect of glare on visual acuity is in progress, and the experiments on the effect of different systems of illumination on the ease of carrying out fine work have been completed.

The report of the Wireless Division contains an excellent record of accomplishments during the year, done under the general control of the Radio Research Board. Among other subjects under investigation may be mentioned the properties of aerials for transmission and reception and the methods of measurement of interference; the account of the study and development of apparatus for various purposes is of much interest, including the examination of the performance of amplifiers.

The above necessarily brief summary refers to but a few items in the very extensive programme of work carried out during 1927. The Committee's report is supplemented by more detailed accounts of the activities of the various Departments, which are of value and interest, but too extensive to be usefully abstracted in the space at our disposal.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

New "Tucker" Products.

Included in some recently introduced productions of MESSRS. J. H. TUCKER & CO., LTD., King's Road, Tyseley, Birmingham, are a new universal conduit box, the "Kwikwire" lampholder, and a new bakelite adaptor. The box has two internally projecting lugs at its upper edge, with 2-in. centres, which enable it to be fitted with B.E.S.A. standard, Tucker standard and semi-recessed ceiling roses, sunk sockets or batten lampholders. By the addition of a mounting plate, flat surface-type tumbler switches and china cut-outs may also be fitted. The "Kwikwire" holder has some new and interesting features. The cord-grip embodies an ebonite bush threaded in the cap. This is screwed down so that the leads, which are taken through the bush to the terminals, are gripped between the bottom edge of the bush and "porcelain" element. The plungers and terminals are of the solid one-piece type, and act independently

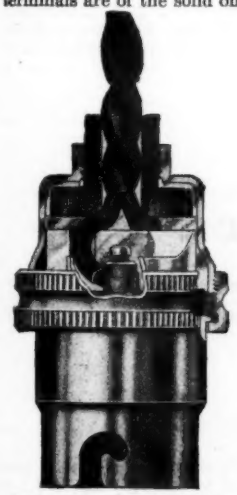


Fig. 1.—"Kwikwire" Lampholder.

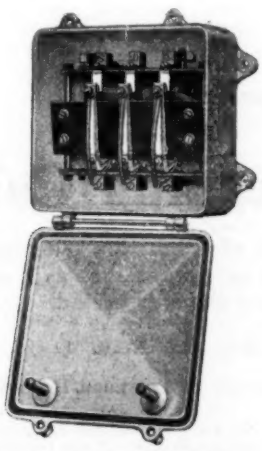


Fig. 2.—3-pole, a.c., Push-button Switch.

of one another. The sectional drawing of the holder shown in fig. 1 indicates the construction of the device. The third product mentioned, the adaptor, is a very neat article, measuring only 1.5 in. in overall depth. It is fitted with "one-piece" contacts, and a wide knurled finger-grip enables the cap to be tightened firmly and securely.

A Push-Button-Controlled Switch.

A recent introduction of MESSRS. CANTIE SWITCHES, LTD., Leighton Works, Carlton Road, Nottingham, is the type VS 20-A contactor switch, which has been designed to meet the demand for a push-button-controlled switch for small motors. It consists of a double- or triple-pole contactor operated by either a push-button in the case, or a remote-control push-button, float-switch or temperature switch. A no-volt release is provided, and excess-current protection can be arranged if desired. The aluminium case is dust-proof, and is arranged for wall mounting. The contactor coils can be wound for voltages of from 100 to 550, and for frequencies of from 20 to 60 cycles. For d.c. circuits, high-resistance units are employed in series with the operating coils; these are easily replaceable. Fig. 2 shows a 3-pole a.c. model with the cover "dropped."

A New Electric Sign.

A new outside electric sign, fig. 3, specially made for the brewing and catering business, but also useful for the individual shopkeeper, has been introduced by Messrs. SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham. It is claimed to be compact and strong, but not too heavy. The body is of copper, with oval "reed and ribbon" mouldings of cast-iron. The suspension hooks and saddle are of malleable iron, and the

Fig. 3.—Electric-Sign Fitting.

brackets of wrought-iron. A novel feature is that both sides are hinged, to facilitate wiring, cleaning of the panels, and changing the lamps. The panels are supplied in four styles, duplex ruby glass, duplex cemented glass, painted glass, and pierced aluminium with opal backing, and may incorporate any desired lettering and any simple silhouette of a trade-mark or other device. The positions of the suspension hooks and loops ensure, it is claimed, the safety of the sign in a high wind, which, while moving the box to and fro, could not possibly blow it off the hooks. The illustration shows the standard way of fixing, but five other methods are available at the same cost. The fitting is well primed and finished outside with a durable dark-grey paint, and inside with a white porcelain enamel.

A Thermal-storage Tank.

The accompanying illustration, fig. 4, is of a new thermal-storage tank which has been introduced by Messrs. GEORGE KENT, LTD., Hibbert Street Works, Luton, Beds. The "G.K." tank is made in two sizes with low loadings, and is suitable for use where special tariffs are in vogue for domestic supplies without peak demands. The smaller 10-gal. size is rated at 750 watts, and the larger 15-gal. tank at 1 kW. A thermostatic cut-out device ensures that no heat is wasted; the water having reached a suitable temperature, the entire

circuit is automatically interrupted until a sufficient fall is experienced to bring the thermostat into operation once more, these actions being quite automatic and depending on temperatures alone. Heat is retained, it is claimed, for a considerable time even when the current is off, owing to the very liberal lagging that is interposed between the inner and the outer container. Tinned-copper is employed for the inner

Fig. 4.—Electric Heat-storage Water Heater.

water tank, and sheet-steel for the outer, which is finished off attractively in art enamel. The heater is of the immersion type, and the element can be replaced in a few moments without breaking a single water joint. Sparking of the thermostat switch is suppressed by suitable condensers. The tank is under no pressure other than that due to the weight of the liquid contents, and hot water is pushed through whenever the stop valve on the cold inlet side is opened. The outlet itself is always open. The sole selling agents for this country are Messrs. Bulpitt & Sons, Camden Street, Birmingham.

New Ultra-Violet Lamps.

The "Medi-Sun" ultra-violet-light apparatus, a recent introduction of the MEDICAL SUPPLY ASSOCIATION, LTD., 167-185, Gray's Inn Road, London, W.C.1, has been designed to meet the requirements of those desirous of obtaining suitable lamps for home use which are "medically" efficient. It is supplied in two models, E.D.428 (d.c.), fig. 5, and E.D.430 (a.c.), and is of the quartz mercury-vapour burner type. The quality of the radiation is claimed to be equal to that given by the

Fig. 5.—Mercury-vapour U.V. Lamp.

larger and more costly units sold by the Association, and the first degree erythema is said to be produced by the new lamps in 3 min. at a distance of 2 ft. Examined under the spectroscope the ultra-violet was seen to cover a wide range. For striking the arc a limit mechanism is provided with each model, and an indicating on-and-off switch is also fitted. The hood is free to rotate in its swivel support and also completely about its vertical support. In the d.c. model the controlling resistances are contained in the ventilated aluminium base. The a.c. lamp is of the same construction, but is fitted with a tri-polar burner, and the arc is supplied through a transformer-convertor unit. The apparatus is finished in polished aluminium with nickel-plated relief. A reducing mask is also supplied with each lamp to afford "spot-light" treatment.

Submarine Telegraph Cables.

A collection of data relative to the design of submarine telegraph cables, which, though the methods described are not original, serves as a record of the progress achieved since the war period.

By R. L. HUGHES, B.Sc., A.M.I.E.E.

(*Extracts from paper published in the* INSTITUTION OF ELECTRICAL ENGINEERS' *Journal.*)

THE theory of the telegraph cable was first seriously developed by Sir William Thomson (later Lord Kelvin), the physical fact on which the theory is based being as follows: any elementary portion of the cable at a short distance from the sending end is a condenser and takes time to become charged to the battery potential on account of the resistance of the conductor up to that point. The charging of another elementary length, at a greater distance from the sending end, is further delayed by the fact that the e.m.f. available does not immediately reach battery potential, but is in itself a growing quantity.

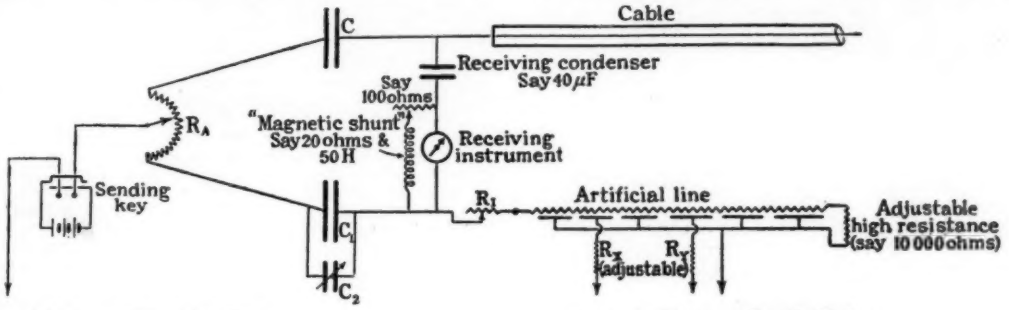
Sir William Thomson's "CR" law is as follows: "The time required for the received current to reach a stated fraction of its maximum strength is proportional to CRl^2," where C=capacity per nautical mile, in farads; R=resistance per nautical mile, in ohms; and l=length of cable, in nautical miles. The rise in the received current after the application of the sending battery voltage can be plotted as the "Kelvin arrival curve"; for a short interval after the application of voltage the current increases very slowly (is, in fact, imperceptible), after which there is a rapid increase which can be made use of to operate the receiving instruments, the remaining portion of the curve being eliminated at the receiving end, so far as the instruments are concerned, by curbing devices. Sir William Thomson considered that for practical purposes the received current commenced its steep rise at a time after the application of the battery equal to (CRl^2/π^2) log 4/3. At any instant of time the received current is proportional to the impressed e.m.f., but an unlimited increase of speed cannot be obtained by increasing the voltage because a very great increase in voltage would be necessary if instruments were to be operated before the commencement of the steep rise; in practice, considerations of safety render the use of higher voltages than 60 to 100 volts undesirable, many cables being worked with about 20 volts, and another very serious objection is connected with duplex operation. The actual speed of any cable in letters per minute multiplied by CRl^2 gives the "speed constant."

Methods of Signalling.—The usual telegraph code is a dot represented by an application of one polarity and a dash by the reverse, of equal duration, while for the spaces separating letters and words no voltage is applied to the cable; this is "recorder code," of which the spaces are an essential part.

"Five-unit" code is sometimes employed in connection with printer apparatus and channel working; in this case every letter consists of five signals (applications of equal length of either positive or negative polarity), and one pole or the other is always applied to the cable; spaces between letters are unnecessary as every letter consists of five units, and a definite separating signal, of five units, is sent between words.

The effective speed for transmitting traffic over a given cable is much the same whichever code is used. The signals are received in distorted form as portions of arrival curves, but are shaped up by "curbing" combinations of condensers and inductive shunts, so that the first changes of received current only affect the receiving instrument, the unwanted portions of the curve being shunted.

Duplex Operation.—For the transmission of messages in both directions simultaneously, several systems have been tried, but the bridge system (fig. 1) is the one in general use. Artificial lines with negligible temperature coefficients for both resistance and capacity are now commonly used to enable a stable balance to be more easily maintained, but the insulation and "absorption" of the cable are not reproduced correctly, nor has any successful attempt been made to reproduce the natural inductance of the cable. Balance has hence become more difficult as greater speeds have been attained, with correspondingly reduced received currents, and some entirely new idea seems to be required. Any attempt to increase the sending voltage and work at a point on the arrival curve before the steep rise would necessitate a duplex balance of very great refinement.



C and C =balancing condensers (about 60 μF)

C_2 =adjustable condenser (say 3 μF adjustable to 0.001 μF)

R_A =apex resistance, usually under 10 ohms

R_1 =10 or 20 ohms, adjustable to 0.01 ohm.

Adjustments of R_A, R_1, R_X and R_Y compensate for the portion of the ingoing impedance of the cable due to its natural inductance, which is not reproduced in the artificial line. R_A can be considered as controlling the phase angle, and the other three adjustments the real part of the impedance.

The receiving instrument is shunted by a "magnetic shunt" having a resistance of about 20 ohms and an inductance of about 50 H which is adjustable, the magnetic shunt being in series with a separate resistance of, say, 100 ohms adjustable to 1 ohm.

This combination of receiving condenser, magnetic shunt, and plain resistance is a simple form of shaping network, its function being to cut off the unwanted portions of the arrival curve.

Fig. 1.—Method of Transmitting Messages in both Directions Simultaneously.

Transmission.—Heaviside was far ahead of his time, and his theory covers many of the recent developments. The importance of his work is only now, some 30 years later, being generally realised. All the successful improvements, therefore, from the early days to quite recent times have been on the lines of (1) increasing the sensitivity of the receiving instruments, thus enabling smaller received currents to be employed; (2) increasing the accuracy of the balance for duplex working, thus enabling the greater sensitivity of the receiving instrument to be employed; and (3) eliminating outside disturbances, which become a limiting factor when the received currents are very small.

A cable laid in 1873 was then capable of working at 115 letters per min. (l.p.m.), but the same cable is now worked duplex at 230 l.p.m.; for many years a bigger core has been inserted in the cable when repairs were necessary, a process which has improved the electrical characteristics.

A considerable number of cables are now working at speed constants of over 800, while practically any cable can be worked over 700, so far as electrical considerations are concerned.

Disturbances.—All cables are worked with an "earth return" circuit; the simplest disturbance remedy is to run a second core in the cable well out to sea and make an earth connection to the sheathing of the cable, and it is now considered desirable to terminate sea earths in reasonably deep water, say 100 fathoms. In addition, when several cables work from one station it is often desirable to earth the sending battery by means of a second earthed core in the cable, shorter than the receiving earth.

The large disturbances occasionally experienced during magnetic storms are of a different nature; very high voltages have been noticed between the cable end and earth on such occasions, and it is not surprising that the insulation has sometimes been damaged.

The cable from Vancouver to Fanning Island, belonging to the Pacific Cable Board, laid in 1902, has a length of 3,458 nautical miles and works at a speed of 140 l.p.m. duplex, which gives the remarkable speed constant of 1,289. The received current is only three or four microamperes, and the high speed is largely due to abnormal freedom from external disturbance.

Speed Increase.—One method of increasing working speed is by decreasing the length, where possible, by putting in intermediate stations for retransmission purposes on islands or at other convenient points between the main termini of the line. When length cannot be reduced for economical reasons it is better to decrease R (*i.e.*, by increasing the size of the conductor). To decrease C appreciably a large increase of insulation is necessary, and the cost of insulating material is many times that of copper; so far 1,100 lb. of copper per nautical mile (1923 Atlantic cable) seems to be the limit.

Higher speeds have, however, accentuated problems which were previously evaded rather than solved. Hitherto the practice of ocean telegraphy has been based rather on direct-current lines, but at high speeds the methods of reasoning suitable for alternating currents are more strictly applicable. This aspect had been considered by Oliver Heaviside and, taking into consideration also the inductance L and leakance G of the cable, he showed that when the characteristics of a cable were such that R/L=G/C (absolute electromagnetic units), signals could be transmitted over any length of cable without suffering distortion. Increasing G, *i.e.*, by decreasing the insulation resistance, although reducing distortion, would also decrease the amplitude of the received current, and the signals would rapidly disappear altogether. It was evident that the addition of continuously distributed inductance to a cable would improve the speed of signalling, but there appeared to be no practical method of accomplishing this; recent strides have followed the solution of this problem.

Calculating working speeds from the attenuation of alternating currents appears to be justified, for if a cable will transmit alternating current, *i.e.*, steady reversals, with sufficient amplitude to affect the receiving instrument, it will transmit all signals. Some letters are made up of two or three impulses of one sign, without any reversal intervening, which coalesce into a long signal of one sign, but this is entirely harmless, as the meaning can be read from the duration of the signal; no difficulty has been found even in devising automatic apparatus for interpreting these "block" signals and, if necessary, converting them into "beats." In practice, when automatic sending is used, the signals are often *transmitted* as blocks.

The highest frequency to be transmitted is therefore that given by the "cross letters," *i.e.*, whose signals involve consecutive alterations, such as the letter C (— - — - in Morse code, or + — + — in recorder code). The objection to this argument is that in telegraphy we are not dealing with the trains of oscillations, but each half-cycle is in itself a signal and may be followed by another half-cycle of the same sign, or of opposite sign, or by a silent space. This results in distortion, which can, however, be largely curbed at the sending and receiving ends.

Methods of Adding Inductance.—Inductance can be added by continuous loading, introduced by Krarup, with a layer of soft iron wire wrapped around the conductor before applying the insulating material, or by inserting Pupin coils at suitable intervals in the circuit, but, as the coils are necessarily large in diameter compared with the cable, there are considerable difficulties in making them of sufficient strength to withstand the strain of being paid out from the laying ship and remain watertight under sea-bottom pressures; it is quite probable that coil-loaded telegraph cables will be laid in the future, but at present the development is entirely in the direction of continuous loading.

To obtain a loading of 50 mH per nautical mile, a permeability of 1,175 was necessary; that of soft iron wire under the same conditions might reach 200 and therefore numerous experimenters had endeavoured to find a material which would give the required high permeability for low magnetising forces, but it was not until 1921 that a patent was applied for by the Western Electric Co. covering "Permalloy," approximately four parts of nickel to one of iron, small percentages of other materials being found advantageous. The "initial permeability," *i.e.*, that for infinitely small magnetising forces, was as high as 13,000, and with a magnetising force corresponding to B=4,300 the permeability reached 87,000 in laboratory experiments, and a cable laid from New York to Fayal (in the Azores) having a working speed of over 1,500 letters per minute proved that cable telegraphy had entered on a totally new phase.

In 1924 a patent* was taken out covering a different alloy, manufactured in England, which was named "Mumetal" and consisted of nickel and iron in proportions similar to those in "Permalloy," but with, in addition, percentages of copper, manganese and small quantities of other elements. This alloy had a higher specific resistance, a lower hysteresis loss and a higher permeability than the "Permalloy" used in 1923, and certain mechanical advantages were claimed for it.

Following closely on this, the Western Electric Co. produced "Chrome Permalloy," with properties very similar to those of Mumetal.

It must be understood that large variations can be obtained by slight modifications in the proportions of the metals composing the alloys and by alterations in the treatment of the materials. The magnetic characteristics of the nickel-iron alloys are somewhat inconstant and are altered by mechanical stress and by variations in the field strength. Simultaneously an alloy called "Invariant" was developed in Germany which was said to offer certain advantages in that its properties were more constant, but it has not developed sufficiently to come into actual use.

Loaded Cables Laid.—Since 1924 the following cables have been completed:—

(1)	Cocos Island-Perth (Western Australia)	Mumetal
(2)	Penzance-Newfoundland	Chrome permalloy
(3)	Newfoundland-New York	
(4)	Germany-Azores	Chrome permalloy
(5)	Vancouver-Fanning Island	Mumetal
(6)	Fanning Island-Fiji	Chrome permalloy

Excepting (4) all these cables were made and laid by British contractors.

Cable Design.—In the case of an unloaded cable, the length being known, it is fairly simple to design a core to give the speed required; knowing the methods of transmission to be employed, the speed constant can be decided and the cable designed to give a suitable value of CRl^2, bearing mechanical limitations in mind. The only doubtful factor would be the magnitude of the disturbance likely to be met with, which can be measured in some localities.

In the case of a loaded cable, however, the same speed of transmission is obtainable with different combinations of resistance, inductance, capacity, and leakance, which characteristics are not constant, and the problem resolves itself into the selection of the most suitable and cheapest combination. The designer is primarily concerned with impedance and attenuation, and several corrections have to be allowed for: for instance, the loading material is affected by stray magnetic fields. During the progress of winding the wire on the conductor, annealing, covering with gutta-percha, &c., the material is subjected to the influence of various fields, and when the coils of core are finally delivered for testing the loading material is in a more or less magnetised condition. It is therefore less susceptible to the weak magnetising forces produced by small signalling or testing currents; *i.e.*, its permeability is reduced and the inductance of such a coil will be lower than it would otherwise be. If "demagnetised" by passing an alternating current through the conductor and reducing the amplitude by small steps from a maximum to nil, a higher value for the inductance will practically always result, but it will not necessarily be the best possible. Accordingly experiments can be carried out to find in what position a coil of core will yield the highest inductance after demagnetising, and once this position is found all subsequent coils should be placed in it for demagnetisation. The position depends on the magnetic meridian and dip at the place and the proximity of masses of iron or strong local fields. The importance of this precaution is greater with tape than with wire loading, as the latter is less affected by stray fields. After this process has been carried out special precautions are taken against the material again becoming magnetised.

The permeability is also very quickly affected by mechanical stress. The wire loading must not be tightly bound around the conductor, and a number of patents have been taken out to avoid this. When the cable is laid, parts of it may be in such depths as 3,000 fathoms, where the pressure on the core would be 8,028 lb. (3.58 tons) per square inch. If this pressure is applied to the loading material uniformly in all directions the permeability will not be impaired, but otherwise strains will be set up due to distortion consequent on the loading wire being pressed against the copper conductor, and a serious loss of inductance will follow. To ensure the uniform distribution of pressure, the loaded conductor would have to be in a fluid and this is actually accomplished by surrounding the conductor with a viscous compound which is somewhat fluid even at sea-bottom temperatures and not harmful to gutta-percha nor absorbed by it.

The core must be handled throughout with considerable care to avoid mechanical strains, and in this connection it has also been noticed that a core whose conductor has been subjected to strain will have a higher added resistance than another core of the same inductance that has not been strained. Inductance will be lost during the processes of sheathing, loading on board ship, and paying out under strain in the earth's field. In practice a figure of 15 per cent. loss from the demagnetised values seems to be suitable for use in designing, but the actual results obtained vary considerably in different cases, for reasons which are not yet clear.

Construction.—The actual construction of the core in the factory provides a number of problems. If wire loading is used the winding process is necessarily slow and a large number of machines must be used. The wire is put on in a single layer only and only one wire can be used, otherwise the increasing length of lay tends to throw away the advantage gained by the use of wire instead of tape. Tape winding is quicker and therefore cheaper, but the actual disadvantages are (1) higher added resistance due to the freer path for eddy currents, and (2) increased variations of inductance with position in the earth's field, due to longer lay. It would be difficult to say at present whether tape or wire loading will ultimately prove the more economical in design.

The permeability varies greatly according to the annealing temperature and the rate of cooling, and the treatment is settled by trial in each case.

The conductor is usually made up of a solid centre wire surrounded by copper strips and the normal difficulties of covering it with gutta-percha are increased by the layer of viscous compound which surrounds the conductor. Any air remaining in the interstices of the loaded conductor would be liable to squeeze out under sea-bottom pressure and form faults, and special precautions have to be taken to avoid this.

The subsequent operations of surrounding the core with brass tape, jute, and sheathing wires suitable to the locality and depth in which it will be laid are normal.

Duplex Operation.—If fig. 1 (duplex of an unloaded cable) is examined it will be appreciated that the duplexing, on similar lines, of a loaded cable with its characteristics varying from moment to moment with both current and frequency requires an artificial line of an extremely complex nature; in fact, the difficulties at a commercial speed at present appear insurmountable.

Accordingly, while a loaded cable may give at least 10 to 12 times the simplex speed possible with an unloaded cable of similar core dimensions, its actual traffic-carrying capacity is only five or six times as great. By using automatic apparatus and working first in one direction and then in the other for comparatively short intervals, what is in effect duplex at half the simplex speed is obtainable.

Conclusion.—The development of submarine telegraphy in the past few years has been of a fundamental character. Not only are higher speeds attainable, but it is no longer of such paramount importance to keep new cables as short as possible; a cable can be designed to work at a given speed over almost any desired length, and probably this will gradually modify the lay-out of the whole of the world's submarine cable system; considerable modifications and improvements in design are likely to be incorporated in any new cables.

The reliability with which a cable can be worked 24 hours per day, year in and year out, ensures that cable telegraphy will for a long time to come prove more satisfactory than wireless for maintaining communication between two points, particularly when dealing with a large and steady volume of traffic; although the capital cost of a cable and its equipment is higher than that of a wireless system, the operating costs are much lower, as is also its rate of depreciation.

*W. S. Smith and H. J. Garnett, British Patent No. 224972.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

Enlargement of Power Stations.

On March 29th, Mr. Lee asked the Minister of Transport whether he was aware that the action of his department in refusing consent in certain cases to the enlargement of existing power stations, or in delaying sanction for long periods, had resulted in many stations being inadequate to deal with the demands of the past winter, and had also prevented any possible reduction in price; and if he proposed to remedy those failings at an early date.

Colonel Ashley said that the Electricity Commissioners were not aware of any instance of refusal or delay of the nature referred to.

Committee on Industry and Trade.

On March 29th, Mr. Ellis asked the President of the Board of Trade when the next report of Sir Arthur Balfour's Committee on Industry and Trade would be issued.

Sir Cunliffe-Lister said he understood that three further volumes, completing the Committee's survey of the industrial situation, had now been compiled. One of them, entitled "Further Factors in Industrial and Commercial Efficiency," was being issued shortly, and the remaining two volumes, which would contain surveys of the textile and metal industries respectively, shortly after Easter. He was informed that the Committee was now considering its final report.

Prepayment-Meter Charges.

On April 3rd Mr. Day asked the Minister of Transport whether he was aware that householders in many districts who took their electric current through a coin-slot meter thereby paid higher charges than householders who ran quarterly accounts, and that this difference in some districts

amounted to as much as 2d. per unit; and whether he would consider the appointment of a departmental committee for the purpose of inquiring into those charges with the object of introducing legislation to make them uniform.

Colonel ASHLEY said that he was aware that there was a difference in the charges, but they were not comparable. In the case of supplies through slot meters, the charge was normally an inclusive one for energy, meter rental, and rental of any wiring and fittings provided by the supply authority. In the case of quarterly accounts, the charges for those items were separate. He did not consider that any useful purpose would be served by the appointment of a committee.

Wireless to Canada.

On April 3rd Sir ROBERT THOMAS asked the Postmaster-General whether, in view of the fact that messages sent by wireless telephony between Western Canada and Great Britain were at present relayed through the United States, he could state when it was intended to establish an all-Canada route.

Sir W. MITCHELL-THOMSON said that the use of the "beam" system for telephonic transmission was still in the experimental stage, and he could not therefore say when a direct service might be practicable.

Artificial Lighting.

On April 3rd Sir ROBERT THOMAS asked the President of the Board of Trade whether, in view of the importance of efficiency in artificial lighting, as affecting the eyesight of the nation, his Department would be represented at the International Illumination Commission to be held in America in September next; and whether facilities would be given for representatives of the National Physical Laboratory and other public institutions, whom this question concerned, also to be present.

Sir P. CUNLIFFE-LISTER said that his Department would not be represented at the Conference mentioned, but the Government would be represented through the Department of Scientific and Industrial Research. He understood that certain of the technical and industrial organisations concerned in the subject would also send representatives.

C.O.D. System to be Extended.

Sir W. MITCHELL-THOMSON informed Mr. SMITH-CARINGTON that arrangements had been made to extend the inland cash-on-delivery service to packets sent by registered letter post on April 30th. He had also arranged with the railway companies operating in Great Britain for the introduction, on the same date, of a cash-on-delivery service for goods other than highly perishable traffic dispatched by railway.

Wireless Telegraphists.

On March 29th, Lord WOLMER, the Assistant Postmaster-General, informed Mr. MacKenzie Livingstone that candidates for the Post Office certificate of proficiency in wireless telegraphy, which was required by all wireless operators on British merchant ships, were trained at specially licensed schools of wireless telegraphy and were examined by the Post Office. So far as he was aware, there was no scarcity of students or of successful candidates. Operators for coast wireless stations or for other Post Office wireless services were trained by the Post Office, which had a large staff of telegraphists to draw upon.

Nickel Plating Defects.

At the March meeting of the Electroplaters' and Depositors' Technical Society, held in conjunction with the London Local Section of the Institute of Metals, Mr. D. J. MacNaughton, A.Inst.P., Assoc.I.E.E., of the Research Department, Woolwich, read a paper on "Common Defects in Nickel Deposits." Dealing with the question of porosity of the deposit, he said it was found that during the initial stages of deposition gas bubbles formed at numerous points on the cathode surface, particularly in areas overlying defects in the steel surface, and if the surface of the steel had been lightly sulphided so that the deposit could be detached, it would be found on examination that holes were present in the deposit where bubbles had been previously attached or evolved. As deposition proceeded, there was usually a marked diminution in the number of bubbles formed, so that an increase in the thickness of the deposit tended to reduce porosity. Pitting, however, was likely to increase, as regarded the diameter of the pits, with increase in the thickness of deposit. Pits were caused by the screening effect of bubbles of gas clinging to the cathode surface. The trend of opinion was that an important influence was exerted by impurities which might be derived from the anodes or the nickel salts, or might consist of organic matter or dust extraneously introduced. It was found that the use of an intermediate layer of electrodeposited copper, such as had been recommended for securing decreased porosity in deposits of nickel, would also secure elimination of the pitting which arose directly as a consequence of depositing upon a steel article having surface defects.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1926.

25,066. "Photo-electric modulator devices." Dubilier Condenser Co. (1925), Ltd. February 16th, 1926. (266,288.)

25,269. "Electric pattern mechanism for singly movable needles of knitting machines." F. H. Rogers (Chemnitzer Strickmaschinen-Fabrik). October 11th, 1926. (267,187.)

25,722. "Means for controlling the speed of electric motors." British Thomson Houston Co., Ltd., and W. J. Pool. October 15th, 1926. (267,190.)

25,971. "Electrical transformers." Burndept Wireless, Ltd., and C. F. Phillips. October 18th, 1926. (267,191.)

28,575. "Control of electrically-propelled vehicles." Electro-Mechanical Brake Co., Ltd., and M. J. Pattison. November 21st, 1926. (267,197.)

29,178. "Induction alternating-current electricity meters." S. Z. de Ferranti and Ferranti, Ltd. November 18th, 1926. (267,200.)

31,474. "Apparatus for exciting a high-frequency current in a coil mounted on a rotary body applicable to the manufacture of thermionic valves." H. Wade (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). December 11th, 1926. (267,210.)

31,544. "Control mechanism for winding engines and the like." General Electric Co., Ltd., and G. S. Woollatt. December 13th, 1926. (267,212.)

31,827. "Telephone systems." Automatic Electric, Inc. December 21st, 1925. (263,168.)

31,911. "Duplex and multiplex telegraphy." H. V. Higgitt and Eastern Telegraph Co., Ltd. December 16th, 1926. (267,229.)

32,022. "Electric repeating instruments or systems." Sperry Gyroscope Co. December 17th, 1925. (263,187.)

32,029. "Couplings or joints for electric cables." W. R. Macdonald. December 17th, 1926. (267,239.)

32,502. "Supporting of overhead conductors." British Insulated Cables, Ltd., J. H. Holland, T. C. Broom, and K. D. Bates. December 23rd, 1926. (267,253.)

32,653. "Prepayment or coin freed electric switches." E. Schattner. December 24th, 1926. (267,254.)

1927.

346. "Thermionic amplifiers." H. V. Higgitt and Eastern Telegraph Co., Ltd. January 5th, 1927. (267,259.)

1,386. "Magnetic-drum separators." Magnet-Werke Ges. Eisenach, Spezialfabrik für Electro-Magnet Apparate. April 10th, 1926. (269,137.)

2,782. "Magneto-electric machines for lighting and ignition purposes on motor vehicles." J. Lucas, Ltd., and E. O. Turner. January 31st, 1927. (267,275.)

2,862. "Telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. February 1st, 1927. (267,276.)

3,210. "Electrical stop motions for knitting machines." T. C. Bromley. February 4th, 1927. (267,282.)

3,252. "High-speed automatic electric circuit breakers." G. A. Juhlin, R. W. Todd, and Metropolitan-Vickers Electrical Co., Ltd. February 4th, 1927. (267,283.)

3,304. "Covers, cowlings, and the like for dynamo-electric and other machines." W. Mackie & Co., Ltd., and A. G. Rook. February 5th, 1927. (267,284.)

4,170. "Multi-channel systems of telegraphy." F. E. Pernot. February 15th, 1927. (Addition to 265,806.) (267,292.)

4,590. "Electric current convertors." A. Kolowrat and E. Czapek. February 20th, 1926. (266,369.)

4,602. "Electric wiring systems for motor-cars and the like vehicles." British Thomson-Houston Co., Ltd., and E. Garton. February 18th, 1927. (267,296.)

4,839. "Electric incandescent lamps." General Electric Co., Ltd., and C. Higgins. February 21st, 1927. (267,299.)

6,585. Translating devices and amplifiers for periodic variations of electric potential." W. J. Brown and Metropolitan-Vickers Electrical Co., Ltd. March 9th, 1927. (267,312.)

7,261. "Time recorder for use in connection with electric tramway, railway, and like systems." A. H. Gledhill. March 16th, 1927. (267,320.)

8,398. "Crystal and like detectors for wireless signalling." E. A. Wixcey. March 26th, 1927. (267,324.)

10,333. "Electric switch and the like operating means." F. Whipp, Whipp and Bourne, Ltd., and Mather & Platt, Ltd. April 14th, 1927. (267,336.)

11,148. "Thermionic valves or electron discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. January 22nd, 1927. (283,941.)

12,453. "Alarm circuit systems, particularly fire-alarm signalling systems." G. C. Synders, C. Gordyn, Junr., J. Van De Kamp and C. E. A. Maitlam May 10th, 1926. (270,762.)

13,150. "Apparatus for electro-plating articles comprising a revolub receptacle." F. Kirschner and J. Hess. May 16th, 1927. (267,350.)

13,588. "Electric mercury vapour apparatus." General Electric Co., Ltd. and E. Weintraub. May 21st, 1926. (271,499.)

15,137. "Means for filling tubular electrodes of electric accumulators." A. Fraass. June 7th, 1927. (Addition to 271,845.) (267,358.)

16,618. "Electric switches." R. Haddan (Sörlandske Elektriske Apparatfabrik). June 22nd, 1927. (267,364.)

17,119. "Illuminated advertising signs." V. Powell June 28th, 1927. (267,366.)

17,771. "Cooling systems for dynamo-electric machines." Akt.-Ges. Brown, Boveri et Cie. July 15th, 1926. (274,450.)

18,836. "Selecting arrangement for fire-alarm and like systems." L. Mellersh-Jackson (Siemens & Halske Akt.-Ges.). July 15th, 1927. (267,377.)

18,845. "Oil-immersed transformers." Akt.-Ges. Brown, Boveri et Cie. July 16th, 1926. (274,495.)

20,318. "Electrical make-and-break apparatus." R. Bosch Akt.-Ges. September 13th, 1926. (277 301.)

20,994. "Brush-holders for dynamo electric machines." L. Schunk and H. Ebe (trading as Schunk & Ebe). August 16th, 1926 (275,989.)

22,166. "Electric arc and resistances welding apparatus." British Thomson-Houston Co., Ltd. August 30th, 1926 (276,664.)

23,067. "Prepayment or coin freed electric switches." E. Schattner. December 24th, 1926. (Divided application on 267,254.) (267,395.)

23,856. "Rolling stock of railways, tramways, and road transport vehicles." P. Algrain. September 30th, 1926. (278,337.)

24,619. "Coloured or diffusing coating for incandescent lamps and similar articles." British Thomson-Houston Co., Ltd. September 20th, 1926. (277,695.)

24,783. "Dimming apparatus for electric lighting systems." R. J. S. Crowe and W. A. Green. September 20th, 1927. (267,406.)

28,196. "Receiving sets for multiple valves." Dr. S. Loewe. October 26th, 1926. (279,843.)

29,892. "Radio receiving apparatus." A. M. Harding and Flash Radio Corporation. November 8th, 1927. (267,425.)

30,178. "Apparatus for delineating electric processes." Siemens-Schuckertwerke Akt.-Ges. November 13th, 1926. (280,564.)

30,407. "Flash lamps." Heka Electrotechnische Fabrik Ges. November 24th, 1926. (281,270.)

32,937. "Manufacture of electric incandescent lamp bulbs from glass tubing." General Electric Co., Ltd. December 9th, 1926. (282,057.)

1928.

1,921. "Telephone systems." Associated Telephone & Telegraph Co. August 26th, 1926. (Divided application on 276,656.) (283,907.)

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ALTON (Hants.).—Additional 20 houses, for the U.D.C.; surveyor.

BEDFORD.—Housing scheme (76), for the T.C.; M. Greenshields, borough engineer.

BEESTON (Notts.).—40 houses, Clifford Avenue, for the U.D.C.; E. A. Bush, Council architect.

BILLINGHAM (Stockton-on-Tees).—Municipal offices, for the U.D.C.; surveyor. Housing scheme (1,000); Industrial Housing Association (No. 2), Ltd. Additional 75 houses for the U.D.C.; surveyor.

BIRKENHEAD.—Motor 'bus garage, for the T.C.; R. W. Johnston, borough engineer (deposit of £1 1s.). Block of offices, Price Street; W. M. Shennan.

BIRMINGHAM.—Secondary school, Burney Lane. Elementary school, Yardley Wood. Special school, Handsworth. Elementary school, Severn Street; Education Committee. Welfare Centre, Shaw Hill Road; Medical Officer of Health. Development of building site, four acres, Shirley Road and Olton Boulevard; F. H. Crabbe.

BOLTON.—Extensions, Weaving shed, Cobden Hill; Barlow and Jones, Ltd. Forty houses off Knowlesley Road; Yates & Partington. Estate development off Salford Road; Bridgwater Estates, Ltd. 104 houses, Paulham Street, and 98 in Tonge Moor Road; Selwood & Lloyd, Ltd. Ninety-six houses, Quebec Street; J. W. Lee, Ltd. Extensions, card room and transformer house, Peaks Place Hill; W. Mather & Co., Ltd. Transformer house, mess room and pump house, Markland Hill filter station; Wm. Gornall & Son, Ltd.

BRADFORD.—Tramway headquarters offices, 11, Forster Square (electric lighting, electric passenger and goods lifts); city architect, Town Hall. Sewage disposal works, Esholt (£500,000); city engineer.

CHELMSFORD.—Houses (56), for the T.C.; F. H. Stewart, builder, Little Waltham. School, Lady Lane (890 places), for the Borough E.C.; Director of Education.

CHELTENHAM.—38 houses, St. Mark's estate; W. Drew. Showroom, lock-ups, and workshops, Lansdown Road; O. H. Goulding.

COALVILLE.—Church, London Road, for the Baptist trustees; secretary.

CRAYFORD (Kent).—Additional 130 houses, for the U.D.C.; surveyor.

CROYDON.—Eight shops with flats, South End (£14,500); borough engineer. Premises, South End; J. Sainsbury, Ltd.

DAGENHAM (Essex).—Houses (50), for British Ropes, Ltd.

DEVONPORT.—Memorial Hall, Stanley Street; St. Stephen's Churchwardens.

DUDLEY.—Conversion of Bush Hotel, High Street, to bank; Barclay's Bank, Ltd.

DUNGENESS.—Directional wireless station, for Trinity House.

DUNTON.—School (£4,292), for Essex E.C.; T. J. Bailey, builder, Chelmsford.

EASTBOURNE.—34 houses, Victoria Drive; W. J. Simms, Sons & Cooke, Ltd. Estate development, Dillingburgh Road; A. Ford, architect. 'Bus depot, Old Town; Motor 'bus manager. Rebuilding All Saints' Church, Carlisle Road; P. D. Stoneham, architect.

EXETER.—434 houses and eight flats for the City Council; city architect.

FOLKESTONE.—Bank premises, Sandgate Road, for Barclay's Bank, Ltd.

GRAYS.—Girls' school (£37,537), for Essex E.C.; J. Stuart, county architect, Chelmsford.

GUILDFORD.—Municipal offices, High Street; Clemence and Co. Development, Aldershot Road Estate; Poyle Charity Trustees. Buildings at water works (£12,000); Thomas & Edge, Woolwich.

HARWICH.—49 houses, Oakley Road Estate; Lister-Mawby (Builders), Ltd.

HASLEMERE.—Hospital extensions (£13,898), for the Committee; Chapman, Lowry & Puttick, builders.

HAWARDEN.—Council offices for the R.D.C.; J. H. Davies and Sons, architects, 14, Newgate Street, Chester (returnable deposit of £2 2s.).

HULL.—Destructor buildings and plant; city architect and J. Watson, quantity surveyor.

ILKESTON.—Estate development, off Park Road; Evans Bros.

IRISH FREE STATE (Dublin).—40 houses, Whitehall, for the Free State Civil Service Housing Association; R. Jones, architect.

(Killavullen, Co. Cork).—Alterations and improvements to Carrigacunna Castle, for Gen. Sir W. R. Marshall; J. J. Bowen, architect, Fermoy.

(Kilmallock, Co. Limerick).—Central creamery for the Kilmallock Co-operative Creamery, Ltd.; the secretary.

LEATHERHEAD.—Varnish factory, for Nobles & Hoare, Ltd., Cornwell Road, London, S.E.

LEEDS.—Re-instatement after fire (£2,000 damage), drapery factory; Hey & Flockton, overall and blouse manufacturers, King's Avenue, Burley Lodge Road.

LONDON (Barking, E.).—Additions, Electric Theatre, Ripple Road; Rose & Bockner. Store, Broadway; British East Light, Ltd.

(East Ham, E.).—Cinema, school site and 16 shops, Green Street; G. Coles. Forty-four houses, Shaftesbury Road; H. W. Binns

(Hackney, E.).—Hall, Wilton Road; W. H. Ansell.

(Ilford, E.).—Extensions, St. Andrew's Hall, with electrical work (£3,000); A. P. Griggs, contractor. Church and schools, Ashurst Drive, Eastern Avenue, for the Baptist trustees; secretary.

(Beckenham, S.E.).—School (£13,323), for the E.C.; J. Elliman & Son, builders.

(Lee, S.E.).—Wesleyan church, Burnt Ash Hill; H. Groves and Son, builders, Greenwich.

MALVERN.—Bank extensions, Lloyd's Bank, Ltd.

MANCHESTER.—Dispensary and health offices, Oxford Road and Denmark Road (£24,000); medical officer of health. Extensions, Exhibition Hall (£19,500); city engineer. High school for boys; Education Committee.

MARKET HARBOROUGH.—Factory extension, Caxton Street; W. Haddon.

NORTHAMPTON.—New wards, Kettering Road; Northampton and County Nursing Home, Ltd. Abattoirs, Ransome Road; Co-operative Wholesale Society, Ltd.

OLDHAM.—Seventy-three houses, Belgrave Road; Frank Lord. Twenty-three houses, Langham Road; H. Partington. Estate development, off Frederick Street; Chamber Hall Estate. Reconstruction destructor works, Robin Hill; cleansing superintendent.

PLYMOUTH.—Alterations, 175, Union Street; General Electric Co., Ltd. Branch library, Wolseley Road; librarian.

ROMFORD.—Houses (33), Knightsbridge Gardens, for Todd Bros. Houses (38), Aveley Road, for W. H. Kitteridge.

ROTHERHAM.—School, Thorpe Hesley, for the borough E.C.; J. A. Mair, secretary (deposit of £1 1s.).

SHEBBEAR.—Extensions at United Methodist College (£4,000); trustees.

SHEFFIELD.—Wesleyan church, Bents Green (£7,000); trustees. Two new ward blocks, Lodge Moor Hospital (deposit £2); W. G. Davies, city architect, Town Hall.

SOUTHPORT.—Library, Ainsdale, for the T.C.; A. E. Jackson, borough engineer (deposit of £1 1s.).

SITTINGBOURNE.—Cottage hospital (£10,453); E. Bishop and Sons, Ltd., builders.

STRETFORD.—Extensions, wire drawing room, Warwick Road; W. T. Glover & Co., Ltd.

STRATHAVEN.—Extensions, Academy, for Lanarkshire E.C.; R. C. T. Mair, clerk, 9, Clydesdale Street, Hamilton.

ST. ALBANS.—X-ray wing, St. Albans and Mid-Herts Hospital; W. G. Marshall, secretary, Church Crescent.

SUTTON COLDFIELD.—Convalescent home, for the National Children's Home.

THORNLIEBANK (Glasgow).—Re-erection of portion of calico printing works (£30,000); the proprietors.

TILBURY.—Additional 315 houses, for the U.D.C.; surveyor.

TORQUAY.—School, Homelands (£14,000); Education Committee. Band enclosure (£25,000); Mr. Adshead. Greyhound race track, Newton Road; Charlesworth and Bennett.

WARRINGTON.—Church hall (£3,500), for St. Thomas's Church, Stockton Heath; W. & Segar Owen, architects; Arthur Swinton, builder.

WATFORD.—51 houses, Leggetts Rise Estate; Kempster and Williams. Factory, Cherry Tree Road; Kempster and Williams.

WIGTON (Cumberland).—Factory for Messrs. Nestle; particulars from the surveyor.

WORKINGTON.—Premises for the Workington and District Industrial and Provident Society (electric lighting); T. Nicholson, architect, 47, John Street.

YEOVIL.—Housing scheme (44), for the R.D.C.; Petter and Warren, architects. Pumping station, for the T.C.; A. J. Price, water engineer, 28, Kingston.